TU MDS ENTRANCE PREPARATION

The Complete Daily Study Book — 6 Days a Week

Tribhuvan University — Institute of Science and Technology
Master in Data Science (MDS) Entrance Examination

Preface

This is the daily edition of the TU MDS entrance preparation book. Every subject — Mathematics, Statistics, Computer Science & IT, Technical English, and Logical Reasoning — is broken into 10 weeks of 6 study days each, so you always know exactly what to read and what to practice today, not just this week.

The underlying material is the same syllabus used in the weekly edition of this book, but every week's notes and quiz questions have been redistributed into six focused daily sessions, each with its own short quiz and answer key. This is deliberate: reviewing and testing yourself in smaller, more frequent doses (spaced repetition) is more effective for retention than reading a large block once and quizzing yourself only at the end of the week.

Structure of each subject part: Week 1 Day 1 through Week 10 Day 6 (60 days), with every week closing on a two-part mock test (that week only, plus a cumulative test covering everything so far) — followed by a Solved Problem Bank and a Glossary for that subject. Part 6 covers Weeks 11-12 (daily revision schedule), exam-day strategy, common mistakes by subject, and a final pre-exam checklist.

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Exam Overview

The MDS entrance exam is a 100-mark, 100-question, 2-hour multiple-choice written test (weighted at 70% of the total admission score), plus academic qualifications (15%) and an interview/presentation (15%). There is no negative marking.

Section	Questions	Marks
I. Mathematics	25	25
II. Statistics	25	25
III. Computer Science & IT	25	25
IV. Technical English	10	10
V. Logical Reasoning	15	15
Total	100	100

Daily study time: roughly 30 minutes per subject per day, 6 days a week (about 2.5-3 hours/day total across all five subjects), with Sunday reserved for mixed review and timed practice.

How This Book Is Organized

Each subject part covers its full 10-week syllabus arc — Mathematics Week 1 Day 1 through Week 10 Day 6, then the same for Statistics, and so on. Every day has focused notes on one sub-topic plus a short quiz with an answer key. This lets you follow a simple daily routine: read today's notes for each of the five subjects, answer today's five quizzes, and move on — no need to hold an entire week's material in your head at once.

If a day's quiz feels too easy, that's a good sign — it means the previous days' concepts are sticking. If a day's quiz feels hard, re-read that day's notes once more before moving to the next day; the daily structure is short specifically so this kind of same-day review costs you very little time.

PART 1

Mathematics

Mathematics carries 25 of the 100 marks in the MDS entrance exam, drawn from calculus, linear algebra, and foundational topics such as sets, functions, and logarithms. This part covers the full mathematics syllabus organized week by week: Weeks 1-6 introduce new material, and Weeks 7-12 consolidate everything through structured revision and heavier practice, mirroring the study plan.

Work through each week's notes with pen and paper — re-derive every formula at least once rather than just reading it. Each week ends with a short quiz; treat it as a checkpoint, not a test.

This part is organized as 10 weeks of 6 study days each (60 days total), matching a Monday-to-Saturday study rhythm with Sunday reserved for mixed review across all five subjects (see Part 6).

Week 1: Sets, Relations, Functions, Graphs, Basic Algebra & Logarithms

Use this log to track your Mathematics study sessions for Week 1. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Sets

Sets

A set is a well-defined collection of distinct objects, called elements. Sets are written using curly braces, e.g. A = {1, 2, 3}. A set with no elements is the empty set, denoted ∅. If every element of A is also in B, A is a subset of B, written $A \subseteq B$.

Relations

A relation on a single set A can have special properties: Reflexive — every a relates to itself (a R a for all a). Symmetric — if a R b then b R a. Transitive — if a R b and b R c then a R c. A relation that is reflexive, symmetric, and transitive is called an equivalence relation, and it partitions A into disjoint equivalence classes.

Graphs of Functions

Exponential functions $y = a^x$ ($a > 1$) grow without bound and never touch the x-axis; logarithmic functions $y = \log_a x$ are their mirror image across $y = x$, defined only for $x > 0$.

Logarithms

The natural logarithm ln x uses base e ≈ 2.71828. $\log_a 1 = 0$ always, and $\log_a a = 1$ always.

Additional Practice Example: Find the domain of $f(x) = 1/(x-3)$.
Solution: *The function is undefined wherever the denominator is zero, i.e. $x = 3$. So the domain is all real numbers except 3: $x \in \mathbb{R}, x \neq 3$.*

Day 1 Quiz

1. If A = {1,2,3} and B = {2,3,4}, then $A \cap B$ is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The value of $\log_2 8$ is:
a) 2
b) 3
c) 4
d) 8

3. Two sets with no common elements are called:
a) Equal sets
b) Disjoint sets

c) Subsets
d) Power sets

Answer Key

1-b 2-b 3-b

Day 2 — Sets

Sets

Key operations: Union (A ∪ B) collects all elements in A or B. Intersection (A ∩ B) collects elements common to both. Difference (A − B) collects elements in A but not B. The complement A^c (relative to a universal set U) collects everything in U not in A.

Relations

Worked Example: On the set of integers, define a R b if a − b is divisible by 3. This is reflexive (a−a=0), symmetric (if 3 | a−b then 3 | b−a), and transitive — so it is an equivalence relation, splitting integers into 3 classes based on remainder mod 3.

Graphs of Functions

A function is even if f(−x) = f(x) (symmetric about the y-axis, e.g. x^2), and odd if f(−x) = −f(x) (symmetric about the origin, e.g. x^3). A function is increasing on an interval if larger inputs always give larger outputs there.

Logarithms

Worked Example: Solve $\log_2(x) + \log_2(x-2) = 3$. Combine: $\log_2[x(x-2)] = 3$, so $x(x-2) = 2^3 = 8$, giving $x^2 - 2x - 8 = 0$, so $(x-4)(x+2) = 0$. Since $x > 2$ is required for the domain, $x = 4$.

Additional Practice Example: Differentiate $y = (3x^2+1)^5$ using the chain rule.
Solution: *Let $u = 3x^2+1$, so $y = u^5$. $dy/du = 5u^4$, $du/dx = 6x$. By the chain rule, $dy/dx = 5u^4 \cdot 6x = 30x(3x^2+1)^4$.*

Day 2 Quiz

1. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

2. $\log_a(mn)$ is equal to:
a) $\log_a m \times \log_a n$
b) $\log_a m + \log_a n$
c) $\log_a m - \log_a n$
d) $(\log_a m)(\log_a n)$

3. A subset of a set A that is not equal to A is called a:
a) Superset

b) Proper subset
c) Power set
d) Universal set

Answer Key

1-c 2-b 3-b

Day 3 — Sets

Sets

De Morgan's Laws: $(A \cup B)^c = A^c \cap B^c$, and $(A \cap B)^c = A^c \cup B^c$. These are used constantly when simplifying set expressions and in probability (complementary events).

Functions

A function f: A → B assigns exactly one element of B (the codomain) to each element of A (the domain). The range (or image) is the actual set of outputs produced. A function is injective (one-to-one) if distinct inputs always give distinct outputs; surjective (onto) if every element of B is hit by some input; bijective if it is both — bijections have inverses.

Basic Algebra

Common identities: $(a+b)^2 = a^2 + 2ab + b^2$, $(a-b)^2 = a^2 - 2ab + b^2$, $a^2 - b^2 = (a-b)(a+b)$, $(a+b)^3 = a^3+3a^2b+3ab^2+b^3$. Factoring quadratics $ax^2 + bx + c$ uses these identities or the quadratic formula.

Additional Practice Example: Evaluate $\int(2x + 3)dx$ from x=0 to x=2.
Solution: *The antiderivative is $x^2 + 3x$. Evaluating: $(2^2 + 3\cdot2) - (0 + 0) = (4+6) - 0 = 10$.*

Day 3 Quiz

1. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

2. De Morgan's law states that $(A \cup B)^c$ equals:
a) $A^c \cup B^c$
b) $A^c \cap B^c$
c) $A \cap B$
d) $A \cup B$

3. The domain of f(x)=1/(x-2) excludes:
a) x=0
b) x=2
c) x=-2
d) x=1

Answer Key

1-b 2-b 3-b

Day 4 — Sets

Sets

The cardinality $|A|$ is the number of elements in A. For finite sets, $|A \cup B| = |A| + |B| - |A \cap B|$ (inclusion-exclusion principle). The power set $P(A)$, the set of all subsets of A, has 2^n elements when $|A| = n$.

Functions

The composition $(g \circ f)(x) = g(f(x))$ applies f first, then g; composition is associative but generally not commutative. If f is bijective, its inverse f^{-1} satisfies $f^{-1}(f(x)) = x$ and $f(f^{-1}(y)) = y$.

Basic Algebra

The quadratic formula: for $ax^2 + bx + c = 0$ $(a \neq 0)$, $x = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a$. The discriminant $b^2 - 4ac$ tells you the nature of the roots: positive gives two real roots, zero gives one repeated real root, negative gives complex roots.

Additional Practice Example: Find the equation of the tangent line to $y = x^2$ at $x = 2$.
Solution: *$y' = 2x$, so the slope at $x=2$ is 4. The point is (2,4). Using point-slope form: $y - 4 = 4(x-2)$, i.e. $y = 4x - 4$.*

Day 4 Quiz

1. If $f(x) = 2x + 3$, then $f^{-1}(x)$ equals:
a) (x-3)/2
b) 2x-3
c) (x+3)/2
d) x/2 - 3

2. A function is surjective if:
a) Every input has a unique output
b) Every element of the codomain is hit by some input
c) It has an inverse
d) It is symmetric

3. log(1) in any valid base equals:
a) 1
b) 0
c) Undefined
d) The base itself

Answer Key

1-a 2-b 3-b

Day 5 — Sets

Sets

Worked Example: If A = {1,2,3,4} and B = {3,4,5,6}, then A ∪ B = {1,2,3,4,5,6}, A ∩ B = {3,4}, A − B = {1,2}, and |A ∪ B| = 4 + 4 − 2 = 6.

Functions

Worked Example: f(x) = 2x + 3 is a bijection from $\mathbb{R}$ to $\mathbb{R}$. Its inverse is found by solving y = 2x+3 for x: x = (y−3)/2, so $f^{-1}(x) = (x-3)/2$.

Basic Algebra

For inequalities, remember that multiplying or dividing both sides by a negative number reverses the inequality sign.

Additional Practice Example: Solve the system: 2x + y = 7, x − y = 2.
Solution: *Adding the equations eliminates y: 3x = 9, so x = 3. Substituting into x − y = 2 gives y = 1. Solution: x=3, y=1.*

Day 5 Quiz

1. A function where f(-x) = f(x) for all x is called:
a) Odd
b) Even
c) Bijective
d) Linear

2. The union of a set with itself equals:
a) The empty set
b) The set itself
c) The universal set
d) Zero

Answer Key

1-b 2-b

Day 6 — Relations

Relations

A relation R from set A to set B is any subset of the Cartesian product A × B (the set of all ordered pairs (a, b) with a ∈ A, b ∈ B). If (a, b) ∈ R we write a R b. The domain is the set of first elements used; the range is the set of second elements used.

Graphs of Functions

Linear functions y = mx + c graph as straight lines with slope m and y-intercept c. Quadratic functions $y = ax^2 + bx + c$ graph as parabolas, opening upward if $a > 0$ and downward if $a < 0$, with vertex at $x = -b/(2a)$.

Logarithms

$\log_a x = y$ means $a^y = x$ ($a > 0$, $a \neq 1$). Laws of logarithms: $\log_a(mn) = \log_a m + \log_a n$; $\log_a(m/n) = \log_a m - \log_a n$; $\log_a(m^k) = k \cdot \log_a m$. The change-of-base formula is $\log_a b = (\log_c\ b)/(\log_c\ a)$ for any base c.

Additional Practice Example: Find the determinant of [[1,2,3],[0,1,4],[5,6,0]] by cofactor expansion along the first row.

Solution: *$det = 1\cdot(1\cdot0-4\cdot6) - 2\cdot(0\cdot0-4\cdot5) + 3\cdot(0\cdot6-1\cdot5) = 1\cdot(-24) - 2\cdot(-20) + 3\cdot(-5) = -24+40-15 = 1$.*

Day 6 Quiz

1. The discriminant of ax^2+bx+c is:

a) b^2-4ac
b) b^2+4ac
c) $4ac-b^2$
d) $2b-4ac$

2. $d/dx(\cos x)^2$ using chain rule equals:

a) $-2\cos x \sin x$
b) $2\cos x \sin x$
c) $-\sin^2 x$
d) $\cos^2 x$

Answer Key

1-a 2-a

Week 1 Mock Test

Two short tests to close out Week 1: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 1 Only

1. If $A = \{1,2,3\}$ and $B = \{2,3,4\}$, then $A \cap B$ is:
a) $\{1,2,3,4\}$
b) $\{2,3\}$
c) $\{1\}$
d) $\{\ \}$

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. If $f(x) = 2x + 3$, then $f^{-1}(x)$ equals:
a) $(x-3)/2$
b) $2x-3$
c) $(x+3)/2$
d) $x/2 - 3$

5. A function where $f(-x) = f(x)$ for all x is called:
a) Odd
b) Even
c) Bijective
d) Linear

6. The discriminant of ax^2+bx+c is:
a) b^2-4ac
b) b^2+4ac
c) $4ac-b^2$
d) $2b-4ac$

7. The value of $\log_2 8$ is:
a) 2
b) 3
c) 4

d) 8

8. $\log_a(mn)$ is equal to:
a) $\log_a m \times \log_a n$
b) $\log_a m + \log_a n$
c) $\log_a m - \log_a n$
d) $(\log_a m)(\log_a n)$

9. De Morgan's law states that $(A \cup B)^c$ equals:
a) $A^c \cup B^c$
b) $A^c \cap B^c$
c) $A \cap B$
d) $A \cup B$

10. A function is surjective if:
a) Every input has a unique output
b) Every element of the codomain is hit by some input
c) It has an inverse
d) It is symmetric

11. The union of a set with itself equals:
a) The empty set
b) The set itself
c) The universal set
d) Zero

12. $d/dx(\cos x)^2$ using chain rule equals:
a) $-2\cos x \sin x$
b) $2\cos x \sin x$
c) $-\sin^2 x$
d) $\cos^2 x$

13. Two sets with no common elements are called:
a) Equal sets
b) Disjoint sets
c) Subsets
d) Power sets

14. A subset of a set A that is not equal to A is called a:
a) Superset
b) Proper subset
c) Power set
d) Universal set

15. The domain of $f(x)=1/(x-2)$ excludes:
a) $x=0$
b) $x=2$
c) $x=-2$
d) $x=1$

16. log(1) in any valid base equals:
a) 1
b) 0
c) Undefined
d) The base itself

Answer Key

1-b 2-c 3-b 4-a 5-b 6-a 7-b 8-b 9-b 10-b 11-b 12-a 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-1

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

Answer Key

1-b 2-c 3-b

Week 2: Differential Calculus — Limits, Continuity & Derivatives

Use this log to track your Mathematics study sessions for Week 2. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Limits

Limits

The limit of f(x) as x approaches a, written lim(x→a) f(x) = L, describes the value f(x) approaches as x gets arbitrarily close to a, whether or not f is actually defined at a. Limits can be evaluated by direct substitution when the function is well-behaved, or via algebraic manipulation (factoring, rationalizing) when substitution gives 0/0.

Derivatives

Chain Rule: for a composite function y = f(g(x)), dy/dx = f'(g(x)) · g'(x). This is the single most-used rule in applied calculus.

Additional Practice Example: A ball is thrown so its height is $h(t) = -5t^2 + 20t$. Find the maximum height.

Solution: *$h'(t) = -10t+20 = 0 \rightarrow t=2$. $h''(t)=-10<0$ confirms a maximum. $h(2) = -20+40 = 20$ (metres).*

Day 1 Quiz

1. d/dx(sin x) equals:

a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

2. d/dx(e^x) equals:

a) e^x
b) xe^{x-1}
c) e^{x-1}
d) ln x

3. A composite function g(f(x)) is evaluated by applying:

a) g first, then f
b) f first, then g
c) Both simultaneously
d) Neither, they cancel

Answer Key

1-a 2-a 3-b

Day 2 — Limits

Limits

Standard limits worth memorizing: $\lim_{x\to 0} (\sin x)/x = 1$; $\lim_{x\to\infty} (1 + 1/x)^x = e$; $\lim_{x\to 0} (e^x - 1)/x = 1$.

Derivatives

Product Rule: $d/dx[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$. Quotient Rule: $d/dx[f(x)/g(x)] = [f'(x)g(x) - f(x)g'(x)] / [g(x)]^2$.

Additional Practice Example: Simplify $\log_2 32 - \log_2 4$.
Solution: *Using the quotient rule, this equals $\log_2(32/4) = \log_2 8 = 3$.*

Day 2 Quiz

1. The derivative of x^3 is:
a) $3x$
b) x^2
c) $3x^2$
d) $x^3/3$

2. $\lim_{x\to 2} (x^2-4)/(x-2)$ equals:
a) 0
b) 2
c) 4
d) undefined

3. $d/dx(4x^5)$ equals:
a) $20x^4$
b) $4x^4$
c) $20x^5$
d) $5x^4$

Answer Key

1-c 2-c 3-a

Day 3 — Limits

Limits

Worked Example: $\lim_{x\to 2} (x^2-4)/(x-2)$. Direct substitution gives 0/0, so factor: $(x-2)(x+2)/(x-2) = x+2$. The limit is $2+2 = 4$.

Derivatives

Worked Example (Chain Rule): $d/dx[\sin(x^2)] = \cos(x^2) \cdot 2x = 2x\cos(x^2)$.

Additional Practice Example: Find the inverse of $f(x) = (x+1)/2$.
Solution: *Set $y=(x+1)/2$, solve for x: $2y = x+1$, so $x = 2y-1$. Thus $f^{-1}(x) = 2x-1$.*

Day 3 Quiz

1. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

2. $d/dx(\ln x)$ equals:
a) x
b) 1/x
c) ln x
d) e^x

3. The derivative of a sum $f(x)+g(x)$ equals:
a) $f'(x)\times g'(x)$
b) $f'(x)+g'(x)$
c) $f'(x)-g'(x)$
d) $f(x)+g'(x)$

Answer Key

1-b 2-b 3-b

Day 4 — Continuity

Continuity

A function f is continuous at x = a if three conditions hold: f(a) is defined, lim(x→a) f(x) exists, and lim(x→a) f(x) = f(a). Intuitively, the graph has no break, jump, or hole at that point.

Derivatives

Worked Example (Product Rule): $d/dx[x^2 \cdot e^x] = 2x \cdot e^x + x^2 \cdot e^x = e^x(2x + x^2)$.

Additional Practice Example: Evaluate the limit $\lim(x\to1)\ (x^3-1)/(x-1)$.
Solution: *Factor the numerator: $x^3-1 = (x-1)(x^2+x+1)$. Cancel $(x-1)$: the limit becomes x^2+x+1 at $x=1$, which is $1+1+1 = 3$.*

Day 4 Quiz

1. A function f is continuous at x=a if lim(x→a)f(x):
a) exists only
b) equals f(a)
c) is infinite
d) is zero

2. A polynomial function is continuous:
a) Nowhere
b) Only at x=0
c) Everywhere
d) Only where defined by a limit

3. lim(x→2) 5 (a constant function) equals:
a) 0
b) 2
c) 5
d) undefined

Answer Key

1-b 2-c 3-c

Day 5 — Continuity

Continuity

Polynomials are continuous everywhere. Rational functions are continuous except where the denominator is zero. A function that is continuous on a closed interval attains a maximum and minimum on that interval (Extreme Value Theorem).

Additional Practice Example: Find the eigenvalues of A = [[5,4],[1,2]].
Solution: *Solve $\det(A-\lambda I)=0$: $(5-\lambda)(2-\lambda)-4=0 \rightarrow \lambda^2-7\lambda+10-4=0 \rightarrow \lambda^2-7\lambda+6=0 \rightarrow (\lambda-1)(\lambda-6)=0$, so $\lambda=1$ or $\lambda=6$.*

Day 5 Quiz

1. d/dx(sin(x²)) equals (using chain rule):
a) cos(x²)
b) 2x·cos(x²)
c) 2x·sin(x²)
d) cos(2x)

2. The derivative of a constant is:
a) 1
b) 0
c) Undefined
d) The constant itself

Answer Key

1-b 2-b

Day 6 — Derivatives

Derivatives

The derivative $f'(x) = \lim(h\to 0)\ [f(x+h) - f(x)]/h$ measures the instantaneous rate of change of f, i.e., the slope of the tangent line at x. Basic rules: $d/dx(x^n) = nx^{n-1}$; $d/dx(\sin x) = \cos x$; $d/dx(\cos x) = -\sin x$; $d/dx(e^x) = e^x$; $d/dx(\ln x) = 1/x$.

Additional Practice Example: A rectangle has perimeter 40. Find its dimensions for maximum area.

Solution: *Let sides be x and 20−x (since 2x+2y=40 → y=20−x). Area A = x(20−x) = 20x−x². A'=20−2x=0 → x=10, so y=10 also — a square of side 10 gives the maximum area of 100.*

Day 6 Quiz

1. The product rule states d/dx[fg] equals:

a) f'g'
b) f'g + fg'
c) f'g - fg'
d) fg' - f'g

2. $\lim(x\to 0)(1-\cos x)/x$ equals:

a) 0
b) 1
c) ∞
d) 1/2

Answer Key

1-b 2-a

Week 2 Mock Test

Two short tests to close out Week 2: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 2 Only

1. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

2. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

3. lim(x→0) (sin x)/x equals:
a) 0
b) 1
c) ∞
d) undefined

4. A function f is continuous at x=a if lim(x→a)f(x):
a) exists only
b) equals f(a)
c) is infinite
d) is zero

5. d/dx(sin(x^2)) equals (using chain rule):
a) cos(x^2)
b) 2x·cos(x^2)
c) 2x·sin(x^2)
d) cos(2x)

6. The product rule states d/dx[fg] equals:
a) f'g'
b) f'g + fg'
c) f'g - fg'
d) fg' - f'g

7. d/dx(e^x) equals:
a) e^x
b) xe^{x-1}
c) e^{x-1}

d) ln x

8. $\lim(x\to 2)\ (x^2-4)/(x-2)$ equals:
a) 0
b) 2
c) 4
d) undefined

9. $d/dx(\ln x)$ equals:
a) x
b) 1/x
c) ln x
d) e^x

10. A polynomial function is continuous:
a) Nowhere
b) Only at x=0
c) Everywhere
d) Only where defined by a limit

11. The derivative of a constant is:
a) 1
b) 0
c) Undefined
d) The constant itself

12. $\lim(x\to 0)(1-\cos x)/x$ equals:
a) 0
b) 1
c) ∞
d) 1/2

13. A composite function g(f(x)) is evaluated by applying:
a) g first, then f
b) f first, then g
c) Both simultaneously
d) Neither, they cancel

14. $d/dx(4x^5)$ equals:
a) $20x^4$
b) $4x^4$
c) $20x^5$
d) $5x^4$

15. The derivative of a sum f(x)+g(x) equals:
a) f'(x)×g'(x)
b) f'(x)+g'(x)
c) f'(x)-g'(x)
d) f(x)+g'(x)

16. lim(x→2) 5 (a constant function) equals:
a) 0
b) 2
c) 5
d) undefined

Answer Key

1-a 2-c 3-b 4-b 5-b 6-b 7-a 8-c 9-b 10-c 11-b 12-a 13-b 14-a 15-b 16-c

Part B — Cumulative, Weeks 1-2

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. lim(x→0) (sin x)/x equals:
a) 0
b) 1
c) ∞
d) undefined

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b

Week 3: Applications of Calculus — Maxima/Minima & Integration

Use this log to track your Mathematics study sessions for Week 3. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Maxima and Minima

Maxima and Minima

A critical point of f occurs where f'(x) = 0 or f'(x) is undefined. To classify a critical point, use the Second Derivative Test: if f''(x) > 0, it's a local minimum; if f''(x) < 0, it's a local maximum; if f''(x) = 0, the test is inconclusive and you must check further (e.g. via the First Derivative Test, examining sign changes of f' around the point).

Integration

Applications: integration finds areas between curves, and — relevant to statistics — the total probability under a continuous probability density function over its entire range always integrates to 1.

Additional Practice Example: Evaluate ∫₀^(π/2) cos x dx.
Solution: *The antiderivative of cos x is sin x. Evaluating: sin(π/2) − sin(0) = 1 − 0 = 1.*

Day 1 Quiz

1. Maxima of f(x) occurs where:
a) f'(x)>0
b) f'(x)=0 and f''(x)<0
c) f'(x)=0 and f''(x)>0
d) f''(x)=0 only

2. ∫(1/x) dx equals:
a) ln|x|+C
b) $1/x^2$+C
c) x^{-1}
d) e^x+C

3. $\int_0^1 (3x^2)dx$ equals:
a) 1
b) 3
c) 0
d) 9

Answer Key

1-b 2-a 3-a

Day 2 — Maxima and Minima

Maxima and Minima

For optimization word problems: write the quantity to optimize as a function of one variable using any given constraint, differentiate, set equal to zero, solve, and verify it is indeed a max or min (and check endpoints if the domain is a closed interval).

Additional Practice Example: Solve $2^x = 16$.
Solution: *Rewrite 16 as 2^4, so $2^x = 2^4$, giving $x = 4$ by matching exponents (since the base is the same).*

Day 2 Quiz

1. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

2. For $f(x)=x^2-4x+7$, the minimum value occurs at $x=$
a) 1
b) 2
c) 3
d) 4

3. $\int 6x\,dx$ equals:
a) $3x^2+C$
b) $6x^2+C$
c) $3x+C$
d) $6+C$

Answer Key
1-b 2-b 3-a

Day 3 — Maxima and Minima

Maxima and Minima

Worked Example: Minimize $f(x) = x^2 - 4x + 7$. $f'(x) = 2x - 4 = 0 \rightarrow x = 2$. $f''(x) = 2 > 0$, so $x = 2$ is a minimum; $f(2) = 4 - 8 + 7 = 3$.

Additional Practice Example: Find the rank of the matrix [[2,4],[1,2]].
Solution: *Row 2 (1,2) is exactly half of Row 1 (2,4), so the rows are linearly dependent — the rank is 1, not 2.*

Day 3 Quiz

1. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

2. $\int \cos x\,dx$ equals:
a) sin x + C
b) -sin x + C
c) cos x + C
d) -cos x + C

3. A function's absolute maximum on a closed interval must occur at:
a) Only the endpoints
b) A critical point or an endpoint
c) Only a critical point
d) Nowhere specific

Answer Key

1-b 2-a 3-b

Day 4 — Integration

Integration

Integration reverses differentiation. The indefinite integral $\int f(x)dx = F(x) + C$, where $F'(x) = f(x)$ and C is an arbitrary constant. Basic rules: $\int x^n dx = x^{n+1}/(n+1) + C$ $(n \neq -1)$; $\int (1/x)dx = \ln|x| + C$; $\int e^x dx = e^x + C$; $\int \cos x\, dx = \sin x + C$; $\int \sin x\, dx = -\cos x + C$.

Additional Practice Example: Differentiate $y = x^2\sin(x)$ using the product rule.
Solution: *Let $u=x^2$, $v=\sin(x)$. $u'=2x$, $v'=\cos(x)$. By the product rule, $dy/dx = u'v + uv' = 2x\cdot\sin(x) + x^2\cdot\cos(x)$.*

Day 4 Quiz

1. A critical point occurs where:
a) f(x)=0
b) f'(x)=0 or undefined
c) f''(x)>0
d) f(x) is undefined

2. The Fundamental Theorem of Calculus connects:
a) Limits and continuity
b) Differentiation and integration
c) Sets and functions
d) Matrices and determinants

3. $\int_0^1 1\, dx$ equals:
a) 0
b) 1
c) 2
d) undefined

Answer Key

1-b 2-b 3-b

Day 5 — Integration

Integration

The definite integral $\int_a^b f(x)dx = F(b) - F(a)$ computes the signed area under the curve between x = a and x = b, using the Fundamental Theorem of Calculus.

Additional Practice Example: Solve the inequality $2x - 5 > 3$.
Solution: *Add 5 to both sides: $2x > 8$. Divide by 2: $x > 4$.*

Day 5 Quiz

1. If $f''(x) > 0$ at a critical point, that point is a:
a) Local maximum
b) Local minimum
c) Saddle point
d) Point of discontinuity

2. The area between a curve and the x-axis over [a,b] where $f(x)<0$ is:
a) Positive automatically
b) Negative unless you take the absolute value
c) Always zero
d) Undefined

Answer Key

1-b 2-b

Day 6 — Integration

Integration

Worked Example: $\int_0^1 x\,dx = [x^2/2]_0^1 = 1/2 - 0 = 1/2$.

Additional Practice Example: Find the sum of the first 10 terms of the arithmetic series 3, 7, 11, ...

Solution: *First term $a=3$, common difference $d=4$. Sum formula: $S_n = n/2[2a+(n-1)d] = 5[6+9\times4] = 5\times42 = 210$.*

Day 6 Quiz

1. $\int e^x\,dx$ equals:

a) e^x
b) xe^x
c) e^x+C
d) $\ln x + C$

2. A function has a point of inflection where:

a) $f'(x)=0$ only
b) $f''(x)$ changes sign
c) $f(x)=0$
d) f is discontinuous

Answer Key

1-c 2-b

Week 3 Mock Test

Two short tests to close out Week 3: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 3 Only

1. Maxima of f(x) occurs where:
a) f'(x)>0
b) f'(x)=0 and f''(x)<0
c) f'(x)=0 and f''(x)>0
d) f''(x)=0 only

2. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

3. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

4. A critical point occurs where:
a) f(x)=0
b) f'(x)=0 or undefined
c) f''(x)>0
d) f(x) is undefined

5. If f''(x) > 0 at a critical point, that point is a:
a) Local maximum
b) Local minimum
c) Saddle point
d) Point of discontinuity

6. $\int e^x\,dx$ equals:
a) e^x
b) xe^x
c) e^x+C
d) ln x + C

7. $\int (1/x)\,dx$ equals:
a) $\ln|x|+C$
b) $1/x^2+C$
c) x^{-1}

d) e^x+C

8. For $f(x)=x^2-4x+7$, the minimum value occurs at $x=$

a) 1
b) 2
c) 3
d) 4

9. $\int \cos x\, dx$ equals:

a) $\sin x + C$
b) $-\sin x + C$
c) $\cos x + C$
d) $-\cos x + C$

10. The Fundamental Theorem of Calculus connects:

a) Limits and continuity
b) Differentiation and integration
c) Sets and functions
d) Matrices and determinants

11. The area between a curve and the x-axis over [a,b] where $f(x)<0$ is:

a) Positive automatically
b) Negative unless you take the absolute value
c) Always zero
d) Undefined

12. A function has a point of inflection where:

a) $f'(x)=0$ only
b) $f''(x)$ changes sign
c) $f(x)=0$
d) f is discontinuous

13. $\int_0^1 (3x^2)dx$ equals:

a) 1
b) 3
c) 0
d) 9

14. $\int 6x\, dx$ equals:

a) $3x^2+C$
b) $6x^2+C$
c) $3x+C$
d) $6+C$

15. A function's absolute maximum on a closed interval must occur at:

a) Only the endpoints
b) A critical point or an endpoint
c) Only a critical point
d) Nowhere specific

16. $\int_0^1 1\,dx$ equals:
a) 0
b) 1
c) 2
d) undefined

Answer Key

1-b 2-b 3-b 4-b 5-b 6-c 7-a 8-b 9-a 10-b 11-b 12-b 13-a 14-a 15-b 16-b

Part B — Cumulative, Weeks 1-3

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b

Week 4: Linear Algebra — Matrices, Determinants, Inverse & Rank

Use this log to track your Mathematics study sessions for Week 4. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Matrices and Basic Operations

Matrices and Basic Operations

A matrix is a rectangular array of numbers arranged in rows and columns. An m×n matrix has m rows and n columns. Matrices are added/subtracted entrywise (must be the same size), and multiplied by scalars entrywise. Matrix multiplication A(m×n)·B(n×p) requires the number of columns of A to equal the number of rows of B, producing an m×p result; entry (i,j) is the dot product of row i of A and column j of B.

Inverse and Rank

The rank of a matrix is the number of linearly independent rows (equivalently, columns); it can be found by reducing the matrix to row-echelon form via Gaussian elimination and counting non-zero rows. Rank tells you the dimension of the solution space for associated systems of linear equations: a system Ax = b has a unique solution when rank(A) equals the number of unknowns and matches the rank of the augmented matrix.

Additional Practice Example: Find $\int x \cdot e^x \, dx$ using integration by parts.
Solution: *Integration by parts: $\int u\,dv = uv - \int v\,du$. Let $u=x$, $dv=e^x dx$, so $du=dx$, $v=e^x$. Result: $xe^x - \int e^x dx = xe^x - e^x + C$.*

Day 1 Quiz

1. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

2. Swapping two rows of a matrix does what to its determinant?
a) Doubles it
b) Halves it
c) Flips its sign
d) No effect

3. A homogeneous system Ax=0 always has at least the:
a) No solution
b) Trivial (zero) solution
c) Infinite unique solutions
d) Negative solution

Answer Key

1-b 2-c 3-b

Day 2 — Matrices and Basic Operations

Matrices and Basic Operations

The identity matrix I has 1's on the diagonal and 0's elsewhere, and satisfies AI = IA = A. Matrix multiplication is associative but not commutative in general (AB ≠ BA usually).

Additional Practice Example: Determine whether f(x) = x^3 is odd, even, or neither.
Solution: *$f(-x) = (-x)^3 = -x^3 = -f(x)$, so f is odd — its graph is symmetric about the origin.*

Day 2 Quiz

1. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

2. A square matrix with determinant 0 is called:
a) Symmetric
b) Singular
c) Diagonal
d) Orthogonal

3. The determinant of a 1×1 matrix [k] is:
a) 1
b) 0
c) k
d) k^2

Answer Key

1-c 2-b 3-c

Day 3 — Determinants

Determinants

For a 2×2 matrix [[a,b],[c,d]], det = ad − bc. For a 3×3 matrix, expand along any row/column using cofactors (signed minors). Determinants measure how a matrix scales area/volume, and a matrix is invertible if and only if its determinant is non-zero.

Additional Practice Example: Find the vertex of the parabola $y = 2x^2 - 8x + 3$.
Solution: *The vertex x-coordinate is $-b/2a = 8/4 = 2$. $y(2) = 2(4) - 16 + 3 = 8 - 16 + 3 = -5$. Vertex: $(2, -5)$.*

Day 3 Quiz

1. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

2. det(AB) is equal to:
a) det(A) + det(B)
b) det(A) × det(B)
c) det(A) - det(B)
d) det(A)/det(B)

3. A square matrix with all off-diagonal entries zero is called:
a) Symmetric
b) Diagonal
c) Singular
d) Orthogonal

Answer Key

1-a 2-b 3-b

Day 4 — Determinants

Determinants

Key properties: $\det(AB) = \det(A)\cdot\det(B)$; $\det(A^T) = \det(A)$; swapping two rows flips the sign of the determinant; a matrix with a zero row/column, or two identical rows, has determinant 0.

Additional Practice Example: Solve for x: $3^{x+1} = 27$.
Solution: *$27 = 3^3$, so $3^{x+1} = 3^3$ gives $x+1 = 3$, so $x = 2$.*

Day 4 Quiz

1. For matrices A(2×3) and B(3×4), the product AB has dimensions:
a) 2×4
b) 3×3
c) 4×2
d) 2×3

2. The identity matrix I satisfies:
a) AI = A only
b) IA = A only
c) AI = IA = A
d) AI = 0

3. If det(A)=5, det(2A) for a 2×2 matrix A equals:
a) 5
b) 10
c) 20
d) 2.5

Answer Key

1-a 2-c 3-c

Day 5 — Determinants

Determinants

Worked Example: For [[2,3],[1,4]], det = 2(4) − 3(1) = 8 − 3 = 5.

Additional Practice Example: Find d^2y/dx^2 for $y = x^4 - 3x^2$.
Solution: *First derivative: $4x^3 - 6x$. Second derivative: $12x^2 - 6$.*

Day 5 Quiz

1. det([[2,3],[1,4]]) equals:
a) 11
b) 5
c) 8
d) -5

2. A square matrix equal to its own transpose is called:
a) Diagonal
b) Symmetric
c) Singular
d) Orthogonal

Answer Key

1-b 2-b

Day 6 — Inverse and Rank

Inverse and Rank

The inverse A^{-1} of a square matrix satisfies $AA^{-1} = I$. For a 2×2 matrix [[a,b],[c,d]], $A^{-1} = (1/\det A)\cdot[[d,-b],[-c,a]]$. A matrix has an inverse only if $\det(A) \neq 0$ (it is then called non-singular; otherwise singular).

Additional Practice Example: A 3×3 matrix has two identical columns. What is its determinant?

Solution: *Whenever two rows or columns of a matrix are identical, the determinant is always 0, since the matrix is not full rank.*

Day 6 Quiz

1. Matrix multiplication is generally:

a) Commutative
b) Not commutative
c) Always symmetric
d) Undefined

2. The trace of a matrix is the sum of its:

a) All elements
b) Diagonal elements
c) Off-diagonal elements
d) Row totals

Answer Key

1-b 2-b

Week 4 Mock Test

Two short tests to close out Week 4: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 4 Only

1. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

2. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

3. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

4. For matrices A(2×3) and B(3×4), the product AB has dimensions:
a) 2×4
b) 3×3
c) 4×2
d) 2×3

5. det([[2,3],[1,4]]) equals:
a) 11
b) 5
c) 8
d) -5

6. Matrix multiplication is generally:
a) Commutative
b) Not commutative
c) Always symmetric
d) Undefined

7. Swapping two rows of a matrix does what to its determinant?
a) Doubles it
b) Halves it
c) Flips its sign

d) No effect

8. A square matrix with determinant 0 is called:
a) Symmetric
b) Singular
c) Diagonal
d) Orthogonal

9. det(AB) is equal to:
a) det(A) + det(B)
b) det(A) × det(B)
c) det(A) - det(B)
d) det(A)/det(B)

10. The identity matrix I satisfies:
a) AI = A only
b) IA = A only
c) AI = IA = A
d) AI = 0

11. A square matrix equal to its own transpose is called:
a) Diagonal
b) Symmetric
c) Singular
d) Orthogonal

12. The trace of a matrix is the sum of its:
a) All elements
b) Diagonal elements
c) Off-diagonal elements
d) Row totals

13. A homogeneous system Ax=0 always has at least the:
a) No solution
b) Trivial (zero) solution
c) Infinite unique solutions
d) Negative solution

14. The determinant of a 1×1 matrix [k] is:
a) 1
b) 0
c) k
d) k^2

15. A square matrix with all off-diagonal entries zero is called:
a) Symmetric
b) Diagonal
c) Singular
d) Orthogonal

16. If det(A)=5, det(2A) for a 2×2 matrix A equals:
a) 5
b) 10
c) 20
d) 2.5

Answer Key

1-b 2-c 3-a 4-a 5-b 6-b 7-c 8-b 9-b 10-c 11-b 12-b 13-b 14-c 15-b 16-c

Part B — Cumulative, Weeks 1-4

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

11. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

12. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b 10-b 11-c 12-a

Week 5: Advanced Mathematics — Eigenvalues, Eigenvectors & Vector Spaces

Use this log to track your Mathematics study sessions for Week 5. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Eigenvalues and Eigenvectors

Eigenvalues and Eigenvectors

For a square matrix A, a non-zero vector v is an eigenvector with eigenvalue λ if Av = λv — that is, A stretches/shrinks v without changing its direction. Eigenvalues are found by solving the characteristic equation det(A − λI) = 0.

Additional Practice Example: Find the sum of the interior angles formula application: a hexagon has 6 sides. What is the sum of its interior angles?
Solution: *The formula is (n-2)×180°. For n=6: (6-2)×180 = 4×180 = 720°.*

Day 1 Quiz

1. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

2. The dimension of a vector space equals:
a) The number of vectors in any spanning set
b) The size of a basis
c) The determinant of any matrix representation
d) The rank plus nullity always

3. A vector space's zero vector, under addition, acts as the:
a) Multiplicative identity
b) Additive identity
c) Scalar multiplier
d) Basis vector

Answer Key

1-b 2-b 3-b

Day 2 — Eigenvalues and Eigenvectors

Eigenvalues and Eigenvectors

For a diagonal matrix, the eigenvalues are simply the diagonal entries themselves. For a symmetric matrix, all eigenvalues are guaranteed to be real, and eigenvectors corresponding to distinct eigenvalues are orthogonal — a fact heavily used in Principal Component Analysis (PCA) in data science.

Additional Practice Example: Simplify $(x^2-9)/(x-3)$.
Solution: *Factor the numerator as a difference of squares: $(x-3)(x+3)/(x-3)$. Cancel $(x-3)$ for $x\neq3$, leaving $x+3$.*

Day 2 Quiz

1. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

2. If $Av = \lambda v$ for non-zero v, then v is called a(n):
a) Eigenvalue
b) Eigenvector
c) Basis vector
d) Null vector

3. An eigenvector is always associated with:
a) A unique matrix
b) A specific eigenvalue
c) The identity matrix only
d) No matrix

Answer Key

1-b 2-b 3-b

Day 3 — Eigenvalues and Eigenvectors

Eigenvalues and Eigenvectors

Worked Example: For A = [[4,1],[1,4]], solve det([[4−λ,1],[1,4−λ]]) = 0 → (4−λ)² − 1 = 0 → 4−λ = ±1 → λ = 3 or λ = 5.

Additional Practice Example: Find the slope of the line through (1,2) and (4,11).
Solution: *Slope = (y2-y1)/(x2-x1) = (11-2)/(4-1) = 9/3 = 3.*

Day 3 Quiz

1. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication
c) Both vector addition and scalar multiplication
d) Neither

2. All eigenvalues of a real symmetric matrix are:
a) Complex
b) Real
c) Negative
d) Zero

3. The zero vector is:
a) Never in a vector space
b) Always in every vector space
c) Only in 2D space
d) Undefined

Answer Key

1-c 2-b 3-b

Day 4 — Vector Spaces and Linear Transformations

Vector Spaces and Linear Transformations

A vector space is a set of vectors closed under addition and scalar multiplication, satisfying axioms like associativity, existence of a zero vector, and distributivity. A subset of vectors is linearly independent if no vector in the set can be written as a combination of the others; a basis is a linearly independent set that spans the whole space, and its size is the dimension of the space.

Additional Practice Example: Evaluate 5C2 (combinations of 5 items taken 2 at a time).
Solution: *5C2 = 5!/(2!3!) = (5×4)/(2×1) = 10.*

Day 4 Quiz

1. Eigenvalues are found by solving:
a) det(A)=0
b) det(A-λI)=0
c) A=λI
d) trace(A)=λ

2. PCA in data science primarily relies on:
a) Logarithms
b) Eigenvalues/eigenvectors of the covariance matrix
c) Integration
d) Set theory

3. A set of two parallel (scalar multiples of each other) vectors in R^2 is:
a) Linearly independent
b) Linearly dependent
c) A basis
d) Orthogonal

Answer Key

1-b 2-b 3-b

Day 5 — Vector Spaces and Linear Transformations

Vector Spaces and Linear Transformations

A linear transformation T: V → W preserves vector addition and scalar multiplication: T(u+v) = T(u)+T(v) and T(cu) = cT(u). Every linear transformation between finite-dimensional spaces can be represented by a matrix once bases are chosen.

Additional Practice Example: Solve |x-3| = 5.

Solution: *This splits into two cases: x-3=5 giving x=8, or x-3=-5 giving x=-2. Solutions: x=8 or x=-2.*

Day 5 Quiz

1. For A=[[4,1],[1,4]], the eigenvalues are:

a) 3 and 5
b) 4 and 4
c) 1 and 4
d) 0 and 8

2. Eigenvectors corresponding to the same eigenvalue form a:

a) Single point
b) Subspace (eigenspace)
c) Scalar
d) Matrix inverse

Answer Key

1-a 2-b

Day 6 — Eigenvalues and Eigenvectors (Review)

Eigenvalues and Eigenvectors

For a square matrix A, a non-zero vector v is an eigenvector with eigenvalue λ if Av = λv — that is, A stretches/shrinks v without changing its direction. Eigenvalues are found by solving the characteristic equation det(A − λI) = 0.

Additional Practice Example: Find the sum to infinity of the geometric series 1 + 1/2 + 1/4 + ...
Solution: *Sum to infinity = a/(1-r) = 1/(1-0.5) = 1/0.5 = 2.*

Day 6 Quiz

1. Eigenvectors of a symmetric matrix corresponding to distinct eigenvalues are:
a) Parallel
b) Orthogonal
c) Equal
d) Undefined

2. The trace of a matrix equals the sum of its:
a) Eigenvalues
b) Eigenvectors
c) Determinants
d) Ranks

Answer Key

1-b 2-a

Week 5 Mock Test

Two short tests to close out Week 5: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 5 Only

1. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

2. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

3. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication
c) Both vector addition and scalar multiplication
d) Neither

4. Eigenvalues are found by solving:
a) $\det(A)=0$
b) $\det(A-\lambda I)=0$
c) $A=\lambda I$
d) $\text{trace}(A)=\lambda$

5. For $A=[[4,1],[1,4]]$, the eigenvalues are:
a) 3 and 5
b) 4 and 4
c) 1 and 4
d) 0 and 8

6. Eigenvectors of a symmetric matrix corresponding to distinct eigenvalues are:
a) Parallel
b) Orthogonal
c) Equal
d) Undefined

7. The dimension of a vector space equals:
a) The number of vectors in any spanning set
b) The size of a basis
c) The determinant of any matrix representation

d) The rank plus nullity always

8. If $Av = \lambda v$ for non-zero v, then v is called a(n):
a) Eigenvalue
b) Eigenvector
c) Basis vector
d) Null vector

9. All eigenvalues of a real symmetric matrix are:
a) Complex
b) Real
c) Negative
d) Zero

10. PCA in data science primarily relies on:
a) Logarithms
b) Eigenvalues/eigenvectors of the covariance matrix
c) Integration
d) Set theory

11. Eigenvectors corresponding to the same eigenvalue form a:
a) Single point
b) Subspace (eigenspace)
c) Scalar
d) Matrix inverse

12. The trace of a matrix equals the sum of its:
a) Eigenvalues
b) Eigenvectors
c) Determinants
d) Ranks

13. A vector space's zero vector, under addition, acts as the:
a) Multiplicative identity
b) Additive identity
c) Scalar multiplier
d) Basis vector

14. An eigenvector is always associated with:
a) A unique matrix
b) A specific eigenvalue
c) The identity matrix only
d) No matrix

15. The zero vector is:
a) Never in a vector space
b) Always in every vector space
c) Only in 2D space
d) Undefined

16. A set of two parallel (scalar multiples of each other) vectors in R^2 is:
a) Linearly independent
b) Linearly dependent
c) A basis
d) Orthogonal

Answer Key

1-b 2-b 3-c 4-b 5-a 6-b 7-b 8-b 9-b 10-b 11-b 12-a 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-5

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

11. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

12. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

13. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

14. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

15. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication

c) Both vector addition and scalar multiplication
d) Neither

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b 10-b 11-c 12-a 13-b 14-b 15-c

Week 6: Multivariable Calculus — Partial Derivatives, Gradient & Optimization

Use this log to track your Mathematics study sessions for Week 6. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Partial Derivatives

Partial Derivatives

For a function of several variables f(x,y), the partial derivative ∂f/∂x treats y as a constant and differentiates with respect to x only (and vice versa for ∂f/∂y). This is exactly how gradient descent computes how a loss function changes with respect to each individual model parameter.

Additional Practice Example: Differentiate y = (2x+1)/(x-3) using the quotient rule.
Solution: *u=2x+1, v=x-3. u'=2, v'=1. dy/dx = (u'v-uv')/v² = [2(x-3)-(2x+1)(1)]/(x-3)² = (2x-6-2x-1)/(x-3)² = -7/(x-3)².*

Day 1 Quiz

1. The gradient of a scalar function points in the direction of:
a) Steepest descent
b) Steepest ascent
c) Zero change
d) Constant value

2. The Hessian matrix is used to:
a) Compute integrals
b) Classify critical points of multivariable functions
c) Solve linear systems
d) Find eigenvalues only

3. ∂²f/∂x∂y is called a:
a) First partial derivative
b) Mixed second partial derivative
c) Gradient
d) Determinant

Answer Key

1-b 2-b 3-b

Day 2 — Partial Derivatives

Partial Derivatives

Worked Example: For $f(x,y) = x^2y + 3y^2$, $\partial f/\partial x = 2xy$, and $\partial f/\partial y = x^2 + 6y$.

Additional Practice Example: Find the area of a triangle with vertices (0,0), (4,0), (0,3) using the determinant formula.

Solution: *Area = 1/2|x1(y2-y3)+x2(y3-y1)+x3(y1-y2)| = 1/2|0(0-3)+4(3-0)+0(0-0)| = 1/2|12| = 6.*

Day 2 Quiz

1. Partial derivative $\partial/\partial x(x^2y)$ equals:

a) $2xy$
b) x^2
c) $2x$
d) y^2

2. A double integral computes:

a) A single point value
b) Volume under a surface
c) A derivative
d) A determinant

3. $\nabla f = 0$ identifies:

a) A random point
b) A critical point of a multivariable function
c) An asymptote
d) A domain restriction

Answer Key

1-a 2-b 3-b

Day 3 — Gradient and Optimization

Gradient and Optimization

The gradient $\nabla f = (\partial f/\partial x, \partial f/\partial y, ...)$ is a vector pointing in the direction of steepest ascent of f; its negative points in the direction of steepest descent, which is the basis of the gradient descent algorithm used to train machine learning models.

Additional Practice Example: Solve the equation $\sqrt{(x+2)} = 3$.
Solution: *Square both sides: $x+2 = 9$, so $x = 7$. Check: $\sqrt{9}=3$ ✓.*

Day 3 Quiz

1. A saddle point occurs when:
a) Both second partials are positive
b) The function has neither a max nor min at a critical point
c) The gradient is undefined
d) The function is linear

2. In $\partial f/\partial x$, which variable(s) are treated as constant?
a) x only
b) All other variables
c) None
d) y and x both

3. $\partial/\partial y\ (3x+5y)$ equals:
a) 3
b) 5
c) 3x
d) 5y

Answer Key

1-b 2-b 3-b

Day 4 — Gradient and Optimization

Gradient and Optimization

A critical point of a multivariable function occurs where $\nabla f = 0$. It can be a local max, local min, or a saddle point (neither) — distinguished using the second-order partial derivatives (the Hessian matrix). A saddle point behaves like a minimum along one direction and a maximum along another.

Additional Practice Example: Find the 5th term of the arithmetic sequence with a=2, d=3.
Solution: *$a_n = a + (n-1)d$. $a_5 = 2 + 4(3) = 2+12 = 14$.*

Day 4 Quiz

1. For $f(x,y)=x^2y+3y^2$, $\partial f/\partial y$ equals:
a) 2xy
b) x^2+6y
c) x^2
d) 6y

2. The negative gradient direction is used because it points toward:
a) Steepest ascent
b) Steepest descent
c) No change
d) Undefined direction

3. A saddle point behaves like a max along one direction and a ___ along another.
a) Max
b) Min
c) Zero
d) Undefined value

Answer Key

1-b 2-b 3-b

Day 5 — Gradient and Optimization

Gradient and Optimization

Double integrals $\iint f(x,y)\,dA$ extend the idea of area-under-a-curve to volume-under-a-surface, computed by integrating with respect to one variable at a time while holding the other constant (iterated integration).

Additional Practice Example: Find the domain of $f(x) = 1/(x-3)$.
Solution: *The function is undefined wherever the denominator is zero, i.e. $x = 3$. So the domain is all real numbers except 3: $x \in \mathbb{R}$, $x \neq 3$.*

Day 5 Quiz

1. Gradient descent moves parameters in the direction of:
a) The gradient
b) The negative gradient
c) A random vector
d) The Hessian

2. The gradient vector is always:
a) Tangent to level curves
b) Perpendicular to level curves
c) Parallel to the x-axis
d) Zero everywhere

Answer Key

1-b 2-b

Day 6 — Partial Derivatives (Review)

Partial Derivatives

For a function of several variables f(x,y), the partial derivative $\partial f/\partial x$ treats y as a constant and differentiates with respect to x only (and vice versa for $\partial f/\partial y$). This is exactly how gradient descent computes how a loss function changes with respect to each individual model parameter.

Additional Practice Example: Differentiate $y = (3x^2+1)^5$ using the chain rule.
Solution: *Let $u = 3x^2+1$, so $y = u^5$. $dy/du = 5u^4$, $du/dx = 6x$. By the chain rule, $dy/dx = 5u^4 \cdot 6x = 30x(3x^2+1)^4$.*

Day 6 Quiz

1. A critical point of a multivariable function occurs where:
a) f=0
b) ∇f=0
c) f is undefined
d) ∇f is maximum

2. A function of two variables can have a local max, local min, or:
a) No other option
b) A saddle point
c) Only a max
d) Only a min

Answer Key

1-b 2-b

Week 6 Mock Test

Two short tests to close out Week 6: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 6 Only

1. The gradient of a scalar function points in the direction of:
a) Steepest descent
b) Steepest ascent
c) Zero change
d) Constant value

2. Partial derivative $\partial/\partial x(x^2y)$ equals:
a) $2xy$
b) x^2
c) $2x$
d) y^2

3. A saddle point occurs when:
a) Both second partials are positive
b) The function has neither a max nor min at a critical point
c) The gradient is undefined
d) The function is linear

4. For $f(x,y)=x^2y+3y^2$, $\partial f/\partial y$ equals:
a) $2xy$
b) x^2+6y
c) x^2
d) $6y$

5. Gradient descent moves parameters in the direction of:
a) The gradient
b) The negative gradient
c) A random vector
d) The Hessian

6. A critical point of a multivariable function occurs where:
a) $f=0$
b) $\nabla f=0$
c) f is undefined
d) ∇f is maximum

7. The Hessian matrix is used to:
a) Compute integrals
b) Classify critical points of multivariable functions
c) Solve linear systems

d) Find eigenvalues only

8. A double integral computes:
a) A single point value
b) Volume under a surface
c) A derivative
d) A determinant

9. In $\partial f/\partial x$, which variable(s) are treated as constant?
a) x only
b) All other variables
c) None
d) y and x both

10. The negative gradient direction is used because it points toward:
a) Steepest ascent
b) Steepest descent
c) No change
d) Undefined direction

11. The gradient vector is always:
a) Tangent to level curves
b) Perpendicular to level curves
c) Parallel to the x-axis
d) Zero everywhere

12. A function of two variables can have a local max, local min, or:
a) No other option
b) A saddle point
c) Only a max
d) Only a min

13. $\partial^2 f/\partial x \partial y$ is called a:
a) First partial derivative
b) Mixed second partial derivative
c) Gradient
d) Determinant

14. $\nabla f = 0$ identifies:
a) A random point
b) A critical point of a multivariable function
c) An asymptote
d) A domain restriction

15. $\partial/\partial y\ (3x+5y)$ equals:
a) 3
b) 5
c) 3x
d) 5y

16. A saddle point behaves like a max along one direction and a ___ along another.
a) Max
b) Min
c) Zero
d) Undefined value

Answer Key

1-b 2-a 3-b 4-b 5-b 6-b 7-b 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-6

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

11. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

12. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

13. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

14. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

15. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication

c) Both vector addition and scalar multiplication
d) Neither

16. The gradient of a scalar function points in the direction of:
a) Steepest descent
b) Steepest ascent
c) Zero change
d) Constant value

17. Partial derivative $\partial/\partial x(x^2y)$ equals:
a) $2xy$
b) x^2
c) $2x$
d) y^2

18. A saddle point occurs when:
a) Both second partials are positive
b) The function has neither a max nor min at a critical point
c) The gradient is undefined
d) The function is linear

Answer Key

1-b	*2-c*	*3-b*	*4-a*	*5-c*	*6-b*	*7-b*	*8-b*	*9-b*	*10-b*	*11-c*	*12-a*	*13-b*	*14-b*	*15-c*	*16-b*	*17-a*	*18-b*

Week 7: Revision — Limits, Derivatives & Integration Consolidated

Use this log to track your Mathematics study sessions for Week 7. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Consolidated Review

Consolidated Review

This week re-derive, from memory, the derivative and integral of each standard function: x^n, sin x, cos x, tan x, e^x, ln x. Then work through the chain, product, and quotient rules until applying them feels automatic rather than something you look up.

Extra Practice Problems

4) Find the second derivative of $f(x) = x^4 - 2x^2$. (Answer: $f''(x) = 12x^2 - 4$)

Additional Practice Example: Evaluate $\int(2x + 3)dx$ from x=0 to x=2.
Solution: *The antiderivative is $x^2 + 3x$. Evaluating: $(2^2 + 3\cdot2) - (0 + 0) = (4+6) - 0 = 10$.*

Day 1 Quiz

1. The derivative of tan x is:
a) $\sec^2 x$
b) $\csc^2 x$
c) $-\sec^2 x$
d) sec x tan x

2. d/dx(ln(2x)) equals:
a) 1/(2x)
b) 1/x
c) 2/x
d) ln 2

3. A function is differentiable at a point only if it is first:
a) Bounded there
b) Continuous there
c) Increasing there
d) Concave there

Answer Key

1-a 2-b 3-b

Day 2 — Consolidated Review

Consolidated Review

A useful drill: given any function built from sums, products, or compositions of the standard functions, differentiate it in under 60 seconds. Speed here compounds — this is the single most time-consuming section for most examinees under exam pressure.

Extra Practice Problems

5) Evaluate $\int_1^2 (2x)dx$. (Answer: 3)

Additional Practice Example: Find the equation of the tangent line to $y = x^2$ at $x = 2$.
Solution: *$y' = 2x$, so the slope at $x=2$ is 4. The point is (2,4). Using point-slope form: $y - 4 = 4(x-2)$, i.e. $y = 4x - 4$.*

Day 2 Quiz

1. d/dx[cos(3x)] equals:
a) -sin(3x)
b) -3sin(3x)
c) 3sin(3x)
d) sin(3x)

2. The quotient rule is applied when differentiating:
a) A sum of functions
b) A product of functions
c) A ratio of functions
d) A constant

3. d/dx(cot x) equals:
a) $-\csc^2 x$
b) $\csc^2 x$
c) $-\sec^2 x$
d) $\cot^2 x$

Answer Key

1-b 2-c 3-a

Day 3 — Consolidated Review

Consolidated Review

Common mistake to eliminate: forgetting the chain rule's 'inner derivative' factor, e.g. writing d/dx[cos(3x)] = −sin(3x) instead of the correct −3sin(3x).

Additional Practice Example: Solve the system: 2x + y = 7, x − y = 2.
Solution: *Adding the equations eliminates y: 3x = 9, so x = 3. Substituting into x − y = 2 gives y = 1. Solution: x=3, y=1.*

Day 3 Quiz

1. $\int(3x^2+2x)dx$ equals:
a) x^3+x^2+C
b) $3x^3+2x^2+C$
c) x^3+2x+C
d) $6x+2+C$

2. $d/dx(e^{kx})$ equals (k constant):
a) e^{kx}
b) ke^{kx}
c) $kx\cdot e^{kx-1}$
d) e^k

3. $\int x^{-1}\,dx$ (x>0) equals:
a) $-1/x^2+C$
b) $\ln x+C$
c) x^0+C
d) $1/x+C$

Answer Key

1-a 2-b 3-b

Day 4 — Extra Practice Problems

Extra Practice Problems

1) Differentiate $y = x^3e^x$. (Answer: $3x^2e^x + x^3e^x$)

Additional Practice Example: Find the determinant of [[1,2,3],[0,1,4],[5,6,0]] by cofactor expansion along the first row.

Solution: *det = 1·(1·0−4·6) − 2·(0·0−4·5) + 3·(0·6−1·5) = 1·(−24) − 2·(−20) + 3·(−5) = −24+40−15 = 1.*

Day 4 Quiz

1. lim(x→3)(x²-9)/(x-3) equals:

a) 0
b) 3
c) 6
d) undefined

2. The area under a curve between a and b is computed using:

a) A derivative
b) An indefinite integral only
c) A definite integral
d) A limit only

3. A function's derivative existing at a point implies the function is also:

a) Discontinuous there
b) Continuous there
c) Undefined there
d) Negative there

Answer Key

1-c 2-c 3-b

Day 5 — Extra Practice Problems

Extra Practice Problems

2) Find $\lim_{x\to 3} (x^2-9)/(x-3)$. (Answer: 6)

Additional Practice Example: A ball is thrown so its height is $h(t) = -5t^2 + 20t$. Find the maximum height.

Solution: *$h'(t) = -10t+20 = 0 \rightarrow t=2$. $h''(t)=-10<0$ confirms a maximum. $h(2) = -20+40 = 20$ (metres).*

Day 5 Quiz

1. The second derivative of x^4-2x^2 is:

a) $4x^3-4x$
b) $12x^2-4$
c) $12x^3-4x$
d) $4x^2-2$

2. $d/dx(\sec x)$ equals:

a) $\sec x \tan x$
b) $-\sec x \tan x$
c) $\tan^2 x$
d) $\sec^2 x$

Answer Key

1-b 2-a

Day 6 — Extra Practice Problems

Extra Practice Problems

3) Evaluate $\int(3x^2 + 2x)dx$. (Answer: $x^3 + x^2 + C$)

Additional Practice Example: Simplify $\log_2 32 - \log_2 4$.
Solution: *Using the quotient rule, this equals $\log_2(32/4) = \log_2 8 = 3$.*

Day 6 Quiz

1. $\int_1^2 2x\,dx$ equals:
a) 1
b) 2
c) 3
d) 4

2. $\int(1/(1+x^2))dx$ equals:
a) arctan(x)+C
b) arcsin(x)+C
c) ln(1+x²)+C
d) 1/(1+x²)+C

Answer Key

1-c 2-a

Week 7 Mock Test

Two short tests to close out Week 7: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 7 Only

1. The derivative of tan x is:
a) $\sec^2 x$
b) $\csc^2 x$
c) $-\sec^2 x$
d) sec x tan x

2. d/dx[cos(3x)] equals:
a) -sin(3x)
b) -3sin(3x)
c) 3sin(3x)
d) sin(3x)

3. $\int(3x^2+2x)dx$ equals:
a) x^3+x^2+C
b) $3x^3+2x^2+C$
c) x^3+2x+C
d) $6x+2+C$

4. $\lim(x\to3)(x^2-9)/(x-3)$ equals:
a) 0
b) 3
c) 6
d) undefined

5. The second derivative of x^4-2x^2 is:
a) $4x^3-4x$
b) $12x^2-4$
c) $12x^3-4x$
d) $4x^2-2$

6. $\int_1^2 2x\,dx$ equals:
a) 1
b) 2
c) 3
d) 4

7. d/dx(ln(2x)) equals:
a) 1/(2x)
b) 1/x
c) 2/x

d) ln 2

8. The quotient rule is applied when differentiating:
a) A sum of functions
b) A product of functions
c) A ratio of functions
d) A constant

9. $d/dx(e^{kx})$ equals (k constant):
a) e^{kx}
b) ke^{kx}
c) $kx \cdot e^{kx-1}$
d) e^{k}

10. The area under a curve between a and b is computed using:
a) A derivative
b) An indefinite integral only
c) A definite integral
d) A limit only

11. d/dx(sec x) equals:
a) sec x tan x
b) -sec x tan x
c) $\tan^2 x$
d) $\sec^2 x$

12. $\int(1/(1+x^2))dx$ equals:
a) arctan(x)+C
b) arcsin(x)+C
c) $\ln(1+x^2)+C$
d) $1/(1+x^2)+C$

13. A function is differentiable at a point only if it is first:
a) Bounded there
b) Continuous there
c) Increasing there
d) Concave there

14. d/dx(cot x) equals:
a) $-\csc^2 x$
b) $\csc^2 x$
c) $-\sec^2 x$
d) $\cot^2 x$

15. $\int x^{-1}\,dx$ $(x>0)$ equals:
a) $-1/x^2+C$
b) ln x+C
c) x^0+C
d) 1/x+C

16. A function's derivative existing at a point implies the function is also:
a) Discontinuous there
b) Continuous there
c) Undefined there
d) Negative there

Answer Key

1-a 2-b 3-a 4-c 5-b 6-c 7-b 8-c 9-b 10-c 11-a 12-a 13-b 14-a 15-b 16-b

Part B — Cumulative, Weeks 1-7

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x \to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

11. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

12. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

13. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

14. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

15. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication

c) Both vector addition and scalar multiplication
d) Neither

16. The gradient of a scalar function points in the direction of:
a) Steepest descent
b) Steepest ascent
c) Zero change
d) Constant value

17. Partial derivative $\partial/\partial x(x^2y)$ equals:
a) $2xy$
b) x^2
c) $2x$
d) y^2

18. A saddle point occurs when:
a) Both second partials are positive
b) The function has neither a max nor min at a critical point
c) The gradient is undefined
d) The function is linear

19. The derivative of tan x is:
a) $\sec^2 x$
b) $\csc^2 x$
c) $-\sec^2 x$
d) sec x tan x

20. d/dx[cos(3x)] equals:
a) -sin(3x)
b) -3sin(3x)
c) 3sin(3x)
d) sin(3x)

21. $\int(3x^2+2x)dx$ equals:
a) x^3+x^2+C
b) $3x^3+2x^2+C$
c) x^3+2x+C
d) $6x+2+C$

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b 10-b 11-c 12-a 13-b 14-b 15-c 16-b 17-a 18-b 19-a 20-b 21-a

Week 8: Revision — Linear Algebra Consolidated

Use this log to track your Mathematics study sessions for Week 8. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Consolidated Review

Consolidated Review

Revisit matrix operations, determinants, inverses, and rank together this week, since MDS-level questions often combine them — e.g. asking for the inverse and then requiring you to verify it via multiplication, or asking for rank via row reduction rather than a formula.

Extra Practice Problems

4) Solve using matrices: x+y=5, 2x−y=1. (Answer: x=2, y=3)

Additional Practice Example: Find the inverse of f(x) = (x+1)/2.
Solution: *Set y=(x+1)/2, solve for x: 2y = x+1, so x = 2y−1. Thus* $f^{-1}(x) = 2x-1$.

Day 1 Quiz

1. The inverse of [[3,1],[2,1]] is:
a) [[1,-1],[-2,3]]
b) [[1,1],[2,3]]
c) [[-1,1],[2,-3]]
d) [[1,-1],[2,3]]

2. Solving x+y=5, 2x-y=1 gives:
a) x=1,y=4
b) x=2,y=3
c) x=3,y=2
d) x=0,y=5

3. A matrix multiplied by its inverse always gives:
a) The zero matrix
b) The identity matrix
c) The transpose
d) A diagonal matrix of eigenvalues

Answer Key

1-a 2-b 3-b

Day 2 — Consolidated Review

Consolidated Review

Practice row-reducing 3×3 matrices to echelon form by hand: this single skill underlies computing rank, solving systems of equations, and finding determinants via cofactor expansion or elimination.

Additional Practice Example: Evaluate the limit $\lim_{x\to 1} (x^3-1)/(x-1)$.
Solution: *Factor the numerator: $x^3-1 = (x-1)(x^2+x+1)$. Cancel $(x-1)$: the limit becomes x^2+x+1 at $x=1$, which is $1+1+1 = 3$.*

Day 2 Quiz

1. The rank of [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1
b) 2
c) 3
d) 0

2. A matrix and its transpose always have:
a) Different determinants
b) The same determinant
c) Different rank
d) No relationship

3. If AB=I for square matrices A,B, then B is called A's:
a) Transpose
b) Inverse
c) Cofactor
d) Adjugate only

Answer Key

1-b 2-b 3-b

Day 3 — Consolidated Review

Consolidated Review

Remember the shortcut for 2×2 inverses: $A^{-1} = (1/\det A)[[d,-b],[-c,a]]$ for $A=[[a,b],[c,d]]$ — this is worth memorizing cold since it appears frequently.

Additional Practice Example: Find the eigenvalues of A = [[5,4],[1,2]].
Solution: *Solve $\det(A-\lambda I)=0$: $(5-\lambda)(2-\lambda) - 4 = 0 \rightarrow \lambda^2 - 7\lambda + 10 - 4 = 0 \rightarrow \lambda^2 - 7\lambda + 6 = 0 \rightarrow (\lambda-1)(\lambda-6)=0$, so $\lambda=1$ or $\lambda=6$.*

Day 3 Quiz

1. If det(A)=4 and det(B)=3, det(AB) equals:
a) 7
b) 1
c) 12
d) 3/4

2. If a matrix has a full row of zeros, its determinant is:
a) 1
b) Undefined
c) 0
d) Equal to the trace

3. A homogeneous linear system always has at least how many solutions?
a) 0
b) 1 (the trivial solution)
c) Infinite always
d) 2

Answer Key

1-c 2-c 3-b

Day 4 — Extra Practice Problems

Extra Practice Problems

1) Find the inverse of [[3,1],[2,1]]. (det = 1, inverse = [[1,−1],[−2,3]])

Additional Practice Example: A rectangle has perimeter 40. Find its dimensions for maximum area.

Solution: *Let sides be x and 20−x (since 2x+2y=40 → y=20−x). Area A = x(20−x) = 20x−x². A'=20−2x=0 → x=10, so y=10 also — a square of side 10 gives the maximum area of 100.*

Day 4 Quiz

1. Row-reducing a matrix to echelon form helps compute:

a) Only the trace
b) Rank, determinant, and solve systems
c) Only eigenvalues
d) Only the transpose

2. Cofactor expansion is a method to compute a matrix's:

a) Rank
b) Determinant
c) Trace
d) Eigenvector

3. $\det(A^T)$ compares to $\det(A)$ as:

a) Always different
b) Always equal
c) Always negative of it
d) Always zero

Answer Key

1-b 2-b 3-b

Day 5 — Extra Practice Problems

Extra Practice Problems

2) Find the rank of [[1,2,3],[2,4,6],[1,1,1]]. (Answer: 2, since row 2 = 2×row 1)

Additional Practice Example: Evaluate ∫₀^(π/2) cos x dx.
Solution: *The antiderivative of cos x is sin x. Evaluating: sin(π/2) − sin(0) = 1 − 0 = 1.*

Day 5 Quiz

1. A system of 2 equations in 2 unknowns with a unique solution has coefficient matrix rank:
a) 0
b) 1
c) 2
d) undefined

2. If det(A)=0, the system Ax=b has:
a) Always a unique solution
b) No solution or infinitely many, depending on b
c) Always infinite solutions
d) Always no solution

Answer Key

1-c 2-b

Day 6 — Extra Practice Problems

Extra Practice Problems

3) If det(A)=4 and det(B)=3, find det(AB). (Answer: 12)

Additional Practice Example: Solve $2^x = 16$.
Solution: *Rewrite 16 as 2^4, so $2^x = 2^4$, giving $x = 4$ by matching exponents (since the base is the same).*

Day 6 Quiz

1. For A=[[a,b],[c,d]], A^{-1} requires dividing by:
a) a+d
b) ad+bc
c) det(A) = ad-bc
d) a-d

2. The transpose of a product $(AB)^t$ equals:
a) A^tB^t
b) B^tA^t
c) $(BA)^{t-1}$
d) AB

Answer Key

1-c 2-b

Week 8 Mock Test

Two short tests to close out Week 8: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 8 Only

1. The inverse of [[3,1],[2,1]] is:
a) [[1,-1],[-2,3]]
b) [[1,1],[2,3]]
c) [[-1,1],[2,-3]]
d) [[1,-1],[2,3]]

2. The rank of [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1
b) 2
c) 3
d) 0

3. If det(A)=4 and det(B)=3, det(AB) equals:
a) 7
b) 1
c) 12
d) 3/4

4. Row-reducing a matrix to echelon form helps compute:
a) Only the trace
b) Rank, determinant, and solve systems
c) Only eigenvalues
d) Only the transpose

5. A system of 2 equations in 2 unknowns with a unique solution has coefficient matrix rank:
a) 0
b) 1
c) 2
d) undefined

6. For A=[[a,b],[c,d]], A^{-1} requires dividing by:
a) a+d
b) ad+bc
c) det(A) = ad-bc
d) a-d

7. Solving x+y=5, 2x-y=1 gives:
a) x=1,y=4
b) x=2,y=3
c) x=3,y=2

d) x=0,y=5

8. A matrix and its transpose always have:
a) Different determinants
b) The same determinant
c) Different rank
d) No relationship

9. If a matrix has a full row of zeros, its determinant is:
a) 1
b) Undefined
c) 0
d) Equal to the trace

10. Cofactor expansion is a method to compute a matrix's:
a) Rank
b) Determinant
c) Trace
d) Eigenvector

11. If det(A)=0, the system Ax=b has:
a) Always a unique solution
b) No solution or infinitely many, depending on b
c) Always infinite solutions
d) Always no solution

12. The transpose of a product $(AB)^t$ equals:
a) A^tB^t
b) B^tA^t
c) $(BA)^{t-1}$
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d) A diagonal matrix of eigenvalues

14. If AB=I for square matrices A,B, then B is called A's:
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15. A homogeneous linear system always has at least how many solutions?
a) 0
b) 1 (the trivial solution)
c) Infinite always
d) 2

16. det(A^T) compares to det(A) as:
a) Always different
b) Always equal
c) Always negative of it
d) Always zero

Answer Key

1-a 2-b 3-c 4-b 5-c 6-c 7-b 8-b 9-c 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-8

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

11. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

12. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

13. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

14. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

15. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication

c) Both vector addition and scalar multiplication
d) Neither

16. The gradient of a scalar function points in the direction of:
a) Steepest descent
b) Steepest ascent
c) Zero change
d) Constant value

17. Partial derivative $\partial/\partial x(x^2y)$ equals:
a) $2xy$
b) x^2
c) $2x$
d) y^2

18. A saddle point occurs when:
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b) The function has neither a max nor min at a critical point
c) The gradient is undefined
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b) -3sin(3x)
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d) sin(3x)

21. $\int(3x^2+2x)dx$ equals:
a) x^3+x^2+C
b) $3x^3+2x^2+C$
c) x^3+2x+C
d) $6x+2+C$

22. The inverse of [[3,1],[2,1]] is:
a) [[1,-1],[-2,3]]
b) [[1,1],[2,3]]
c) [[-1,1],[2,-3]]
d) [[1,-1],[2,3]]

23. The rank of [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1
b) 2
c) 3

d) 0

24. If det(A)=4 and det(B)=3, det(AB) equals:

a) 7

b) 1

c) 12

d) 3/4

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b 10-b 11-c 12-a 13-b 14-b 15-c 16-b 17-a 18-b 19-a 20-b 21-a 22-a 23-b 24-c

Week 9: Formula Revision — Consolidated Reference Sheet

Use this log to track your Mathematics study sessions for Week 9. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Master Formula Sheet

Master Formula Sheet

Derivatives: $d/dx(x^n)=nx^{n-1}$, $d/dx(\sin x)=\cos x$, $d/dx(\cos x)=-\sin x$, $d/dx(\tan x)=\sec^2 x$, $d/dx(e^x)=e^x$, $d/dx(\ln x)=1/x$, $d/dx(a^x)=a^x \ln a$.

Additional Practice Example: Find the rank of the matrix [[2,4],[1,2]].
Solution: *Row 2 (1,2) is exactly half of Row 1 (2,4), so the rows are linearly dependent — the rank is 1, not 2.*

Day 1 Quiz

1. $d/dx(a^x)$ equals (a constant):
a) a^x
b) $a^x \ln a$
c) $x \cdot a^{x-1}$
d) $\ln a$

2. The quadratic formula gives roots of:
a) Any polynomial
b) $ax^2+bx+c=0$
c) $ax+b=0$
d) Any exponential equation

3. The natural domain of $f(x)=\sqrt{x}$ excludes:
a) $x>0$
b) $x=0$
c) $x<0$
d) $x=1$

Answer Key

1-b 2-b 3-c

Day 2 — Master Formula Sheet

Master Formula Sheet

Integrals: $\int x^n dx = x^{n+1}/(n+1)+C$, $\int (1/x)dx = \ln|x|+C$, $\int e^x dx = e^x+C$, $\int \sin x\, dx = -\cos x+C$, $\int \cos x\, dx = \sin x+C$.

Additional Practice Example: Differentiate $y = x^2\sin(x)$ using the product rule.
Solution: *Let $u=x^2$, $v=\sin(x)$. $u'=2x$, $v'=\cos(x)$. By the product rule, $dy/dx = u'v + uv' = 2x\cdot\sin(x) + x^2\cdot\cos(x)$.*

Day 2 Quiz

1. $\int e^x dx$ equals:
a) e^x
b) e^x+C
c) xe^x+C
d) $\ln x+C$

2. $\int (1/x)dx$ equals:
a) $x^{-2}+C$
b) $\ln|x|+C$
c) $1/x^2+C$
d) e^x+C

3. $\int e^x + x dx$ equals:
a) $e^x+x^2/2+C$
b) e^x+x+C
c) $e^x\cdot x+C$
d) $ex+C$

Answer Key

1-b 2-b 3-a

Day 3 — Master Formula Sheet

Master Formula Sheet

Matrices: $\det([[a,b],[c,d]]) = ad - bc$; $A^{-1} = (1/\det A) \cdot \text{adjugate}(A)$; rank via row-echelon form; $Av = \lambda v$ defines eigenvalues/eigenvectors, solved via $\det(A - \lambda I) = 0$.

Additional Practice Example: Solve the inequality $2x - 5 > 3$.
Solution: *Add 5 to both sides: $2x > 8$. Divide by 2: $x > 4$.*

Day 3 Quiz

1. d/dx(tan x) equals:
a) $\sec^2 x$
b) $-\sec^2 x$
c) $\csc^2 x$
d) sec x

2. $d/dx(x^n)$ equals:
a) nx^n
b) nx^{n-1}
c) x^{n-1}
d) nx^{n+1}

3. A function continuous on [a,b] is guaranteed to have (Extreme Value Theorem):
a) No maximum
b) A maximum and minimum on that interval
c) Infinite maxima
d) Only a minimum

Answer Key

1-a 2-b 3-b

Day 4 — Master Formula Sheet

Master Formula Sheet

Logarithms & Algebra: $\log_a(mn)=\log_a m+\log_a n$; $\log_a(m/n)=\log_a m-\log_a n$; $\log_a(m^k)=k\cdot\log_a m$; quadratic formula $x=[-b\pm\sqrt{(b^2-4ac)}]/2a$.

Additional Practice Example: Find the sum of the first 10 terms of the arithmetic series 3, 7, 11, ...

Solution: *First term $a=3$, common difference $d=4$. Sum formula: $S_n = n/2[2a+(n-1)d] = 5[6+9\times4] = 5\times42 = 210$.*

Day 4 Quiz

1. The adjugate method is used to find a matrix's:
a) Rank
b) Inverse
c) Trace
d) Transpose

2. $\int\cos x\,dx$ equals:
a) -sin x+C
b) sin x+C
c) cos x+C
d) -cos x+C

3. $d/dx(\ln(x^2))$ equals:
a) $1/x^2$
b) $2/x$
c) $2x$
d) $1/(2x)$

Answer Key

1-b 2-b 3-b

Day 5 — Master Formula Sheet

Master Formula Sheet

This week, rewrite this entire formula sheet from memory once a day without looking. Time yourself — you should be able to reproduce it correctly in under 5 minutes by the end of the week.

Additional Practice Example: Find $\int x \cdot e^x \, dx$ using integration by parts.
Solution: *Integration by parts: $\int u\,dv = uv - \int v\,du$. Let $u=x$, $dv=e^x dx$, so $du=dx$, $v=e^x$. Result: $xe^x - \int e^x dx = xe^x - e^x + C$.*

Day 5 Quiz

1. Eigenvalues satisfy the equation:
a) det(A)=0
b) det(A-λI)=0
c) A=λ
d) trace(A)=0

2. $\int_a^a f(x)dx$ (same upper and lower limit) always equals:
a) 1
b) 0
c) f(a)
d) Undefined

Answer Key

1-b 2-b

Day 6 — Master Formula Sheet (Review)

Master Formula Sheet

Derivatives: $d/dx(x^n)=nx^{n-1}$, $d/dx(\sin x)=\cos x$, $d/dx(\cos x)=-\sin x$, $d/dx(\tan x)=\sec^2 x$, $d/dx(e^x)=e^x$, $d/dx(\ln x)=1/x$, $d/dx(a^x)=a^x \ln a$.

Additional Practice Example: Determine whether $f(x) = x^3$ is odd, even, or neither.
Solution: *$f(-x) = (-x)^3 = -x^3 = -f(x)$, so f is odd — its graph is symmetric about the origin.*

Day 6 Quiz

1. $\log_a(m/n)$ equals:
a) $\log_a m \times \log_a n$
b) $\log_a m - \log_a n$
c) $\log_a m + \log_a n$
d) $\log_a(m-n)$

2. $d/dx(\csc x)$ equals:
a) $-\csc x \cot x$
b) $\csc x \cot x$
c) $-\sec x \tan x$
d) $\cot^2 x$

Answer Key

1-b 2-a

Week 9 Mock Test

Two short tests to close out Week 9: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 9 Only

1. $d/dx(a^x)$ equals (a constant):
a) a^x
b) $a^x \ln a$
c) $x \cdot a^{x-1}$
d) $\ln a$

2. $\int e^x dx$ equals:
a) e^x
b) e^x+C
c) xe^x+C
d) $\ln x+C$

3. $d/dx(\tan x)$ equals:
a) $\sec^2 x$
b) $-\sec^2 x$
c) $\csc^2 x$
d) $\sec x$

4. The adjugate method is used to find a matrix's:
a) Rank
b) Inverse
c) Trace
d) Transpose

5. Eigenvalues satisfy the equation:
a) $\det(A)=0$
b) $\det(A-\lambda I)=0$
c) $A=\lambda$
d) $\text{trace}(A)=0$

6. $\log_a(m/n)$ equals:
a) $\log_a m \times \log_a n$
b) $\log_a m - \log_a n$
c) $\log_a m + \log_a n$
d) $\log_a(m-n)$

7. The quadratic formula gives roots of:
a) Any polynomial
b) $ax^2+bx+c=0$
c) $ax+b=0$

d) Any exponential equation

8. $\int(1/x)dx$ equals:

a) $x^{-2}+C$

b) $\ln|x|+C$

c) $1/x^2+C$

d) e^x+C

9. $d/dx(x^n)$ equals:

a) nx^n

b) nx^{n-1}

c) x^{n-1}

d) nx^{n+1}

10. $\int\cos x\,dx$ equals:

a) -sin x+C

b) sin x+C

c) cos x+C

d) -cos x+C

11. $\int_a^a f(x)dx$ (same upper and lower limit) always equals:

a) 1

b) 0

c) f(a)

d) Undefined

12. d/dx(csc x) equals:

a) -csc x cot x

b) csc x cot x

c) -sec x tan x

d) $\cot^2 x$

13. The natural domain of $f(x)=\sqrt{x}$ excludes:

a) $x>0$

b) $x=0$

c) $x<0$

d) $x=1$

14. $\int e^x + x\,dx$ equals:

a) $e^x+x^2/2+C$

b) e^x+x+C

c) $e^x\cdot x+C$

d) ex+C

15. A function continuous on [a,b] is guaranteed to have (Extreme Value Theorem):

a) No maximum

b) A maximum and minimum on that interval

c) Infinite maxima

d) Only a minimum

16. d/dx(ln(x²)) equals:
a) 1/x²
b) 2/x
c) 2x
d) 1/(2x)

Answer Key

1-b 2-b 3-a 4-b 5-b 6-b 7-b 8-b 9-b 10-b 11-b 12-a 13-c 14-a 15-b 16-b

Part B — Cumulative, Weeks 1-9

1. If A = {1,2,3} and B = {2,3,4}, then A ∩ B is:
a) {1,2,3,4}
b) {2,3}
c) {1}
d) { }

2. The power set of a set with 3 elements has how many elements?
a) 3
b) 6
c) 8
d) 9

3. A relation that is reflexive, symmetric and transitive is called:
a) A function
b) An equivalence relation
c) A bijection
d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) sec²x

5. The derivative of x³ is:
a) 3x
b) x²
c) 3x²
d) x³/3

6. lim(x→0) (sin x)/x equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
d) -1

11. A matrix has an inverse only if its determinant is:
a) 0
b) positive
c) non-zero
d) negative

12. The rank of a zero matrix is:
a) 0
b) 1
c) equal to its order
d) undefined

13. Eigenvalues of a diagonal matrix are:
a) The off-diagonal elements
b) The diagonal elements themselves
c) Always zero
d) Always equal

14. A basis of a vector space must be:
a) Linearly dependent and spanning
b) Linearly independent and spanning
c) Just any subset
d) Orthogonal only

15. A linear transformation preserves:
a) Only addition
b) Only scalar multiplication

c) Both vector addition and scalar multiplication
d) Neither

16. The gradient of a scalar function points in the direction of:
a) Steepest descent
b) Steepest ascent
c) Zero change
d) Constant value

17. Partial derivative $\partial/\partial x(x^2y)$ equals:
a) $2xy$
b) x^2
c) $2x$
d) y^2

18. A saddle point occurs when:
a) Both second partials are positive
b) The function has neither a max nor min at a critical point
c) The gradient is undefined
d) The function is linear

19. The derivative of tan x is:
a) $\sec^2 x$
b) $\csc^2 x$
c) $-\sec^2 x$
d) sec x tan x

20. d/dx[cos(3x)] equals:
a) -sin(3x)
b) -3sin(3x)
c) 3sin(3x)
d) sin(3x)

21. $\int(3x^2+2x)dx$ equals:
a) x^3+x^2+C
b) $3x^3+2x^2+C$
c) x^3+2x+C
d) $6x+2+C$

22. The inverse of [[3,1],[2,1]] is:
a) [[1,-1],[-2,3]]
b) [[1,1],[2,3]]
c) [[-1,1],[2,-3]]
d) [[1,-1],[2,3]]

23. The rank of [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1
b) 2
c) 3

d) 0

24. If det(A)=4 and det(B)=3, det(AB) equals:

a) 7
b) 1
c) 12
d) 3/4

25. d/dx(a^x) equals (a constant):

a) a^x
b) $a^x \ln a$
c) $x \cdot a^{x-1}$
d) ln a

26. $\int e^x dx$ equals:

a) e^x
b) e^x+C
c) xe^x+C
d) ln x+C

27. d/dx(tan x) equals:

a) $\sec^2 x$
b) $-\sec^2 x$
c) $\csc^2 x$
d) sec x

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b 10-b 11-c 12-a 13-b 14-b 15-c 16-b 17-a 18-b 19-a 20-b 21-a 22-a 23-b 24-c 25-b 26-b 27-a

Week 10: Mixed Practice — All Mathematics Topics

Use this log to track your Mathematics study sessions for Week 10. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Mixed Problem Set

Mixed Problem Set

This week's math sessions should be 100% mixed practice, drawing randomly across sets, functions, calculus, and linear algebra so you build the skill of recognizing which technique a question needs without being told the chapter — exactly the situation you'll face in the real 100-question paper.

6) Find the rank of the identity 3×3 matrix. (Answer: 3)

Additional Practice Example: Find the vertex of the parabola $y = 2x^2 - 8x + 3$.
Solution: *The vertex x-coordinate is $-b/2a = 8/4 = 2$. $y(2) = 2(4) - 16 + 3 = 8 - 16 + 3 = -5$. Vertex: $(2, -5)$.*

Day 1 Quiz

1. If A={1,2,3,4,5} and B={4,5,6,7}, the symmetric difference AΔB is:
a) {4,5}
b) {1,2,3,6,7}
c) {1,2,3,4,5,6,7}
d) { }

2. A function that is both injective and surjective is called:
a) Linear
b) Bijective
c) Continuous
d) Differentiable

3. Integration by parts is derived from which differentiation rule?
a) Chain rule
b) Product rule
c) Quotient rule
d) Power rule

Answer Key

1-b 2-b 3-b

Day 2 — Mixed Problem Set

Mixed Problem Set

1) If A={1,2,3,4,5} and B={4,5,6,7}, find AΔB (symmetric difference: elements in exactly one set). (Answer: {1,2,3,6,7})

Additional Practice Example: Solve for x: $3^{x+1} = 27$.
Solution: *$27 = 3^3$, so $3^{x+1} = 3^3$ gives $x+1 = 3$, so $x = 2$.*

Day 2 Quiz

1. The derivative of $\ln(x^2+1)$ is:
a) $1/(x^2+1)$
b) $2x/(x^2+1)$
c) $2x$
d) $x/(x^2+1)$

2. The determinant of a matrix with two identical rows is:
a) 1
b) Undefined
c) 0
d) Equal to the trace

3. A bijective function guarantees the existence of a(n):
a) Derivative
b) Inverse function
c) Integral
d) Asymptote

Answer Key

1-b 2-c 3-b

Day 3 — Mixed Problem Set

Mixed Problem Set

2) Differentiate $y = \ln(x^2 + 1)$. (Answer: $2x/(x^2+1)$)

Additional Practice Example: Find d^2y/dx^2 for $y = x^4 - 3x^2$.
Solution: *First derivative: $4x^3 - 6x$. Second derivative: $12x^2 - 6$.*

Day 3 Quiz

1. $\int_0^{\pi} \sin x \, dx$ equals:
a) 0
b) 1
c) 2
d) π

2. $d/dx(\sin x \cdot \cos x)$ using the product rule equals:
a) $\cos^2 x - \sin^2 x$
b) $\cos^2 x + \sin^2 x$
c) $-2\sin x \cos x$
d) $2 \sin x \cos x$

3. The determinant of any orthogonal matrix is:
a) Always 0
b) Always ±1
c) Always negative
d) Undefined

Answer Key

1-c 2-a 3-b

Day 4 — Mixed Problem Set

Mixed Problem Set

3) Evaluate ∫₀^π sin x dx. (Answer: 2)

Additional Practice Example: A 3×3 matrix has two identical columns. What is its determinant?

Solution: *Whenever two rows or columns of a matrix are identical, the determinant is always 0, since the matrix is not full rank.*

Day 4 Quiz

1. The eigenvalues of [[2,0],[0,5]] are:

a) 2 and 5
b) 0 and 7
c) 7 and 10
d) 2 and 0

2. $\int_0^1 e^x\,dx$ equals:

a) e
b) e-1
c) 1
d) e+1

3. Integration and differentiation are, in a specific sense, ___ operations.

a) Identical
b) Inverse of each other
c) Unrelated
d) Always equal in value

Answer Key

1-a 2-b 3-b

Day 5 — Mixed Problem Set

Mixed Problem Set

4) Find the eigenvalues of [[2,0],[0,5]]. (Answer: 2 and 5, since it's diagonal)

Additional Practice Example: Find the sum of the interior angles formula application: a hexagon has 6 sides. What is the sum of its interior angles?

Solution: *The formula is (n-2)×180°. For n=6: (6-2)×180 = 4×180 = 720°.*

Day 5 Quiz

1. Solving $\log_3(x)=4$ gives x =

a) 12
b) 27
c) 64
d) 81

2. A bijective function between two finite sets requires the sets to have:

a) Different sizes
b) The same size
c) No common elements
d) Infinite size

Answer Key

1-d 2-b

Day 6 — Mixed Problem Set

Mixed Problem Set

5) Solve $\log_3(x) = 4$. (Answer: $x = 81$)

Additional Practice Example: Simplify $(x^2-9)/(x-3)$.
Solution: *Factor the numerator as a difference of squares: $(x-3)(x+3)/(x-3)$. Cancel $(x-3)$ for $x \neq 3$, leaving $x+3$.*

Day 6 Quiz

1. The rank of the 3×3 identity matrix is:
a) 0
b) 1
c) 2
d) 3

2. The determinant of a triangular matrix equals:
a) The sum of diagonal entries
b) The product of diagonal entries
c) Zero always
d) The largest entry

Answer Key

1-d 2-b

Week 10 Mock Test

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Part A — Week 10 Only

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a) {4,5}
b) {1,2,3,6,7}
c) {1,2,3,4,5,6,7}
d) { }

2. The derivative of ln(x²+1) is:
a) 1/(x²+1)
b) 2x/(x²+1)
c) 2x
d) x/(x²+1)

3. ∫₀^π sin x dx equals:
a) 0
b) 1
c) 2
d) π

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b) 0 and 7
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c) Continuous

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Part B — Cumulative, Weeks 1-10

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d) A partial order

4. d/dx(sin x) equals:
a) cos x
b) -cos x
c) -sin x
d) $\sec^2 x$

5. The derivative of x^3 is:
a) 3x
b) x^2
c) $3x^2$
d) $x^3/3$

6. $\lim_{x\to 0} (\sin x)/x$ equals:
a) 0
b) 1
c) ∞
d) undefined

7. Maxima of f(x) occurs where:
a) f'(x)>0

b) $f'(x)=0$ and $f''(x)<0$
c) $f'(x)=0$ and $f''(x)>0$
d) $f''(x)=0$ only

8. $\int x\,dx$ equals:
a) x^2
b) $x^2/2 + C$
c) $x + C$
d) 1

9. The definite integral $\int_0^1 x\,dx$ equals:
a) 1
b) 0.5
c) 0
d) 2

10. The determinant of a 2×2 identity matrix is:
a) 0
b) 1
c) 2
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b) Only scalar multiplication

c) Both vector addition and scalar multiplication
d) Neither

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a) Steepest descent
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a) x^3+x^2+C
b) $3x^3+2x^2+C$
c) x^3+2x+C
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22. The inverse of [[3,1],[2,1]] is:
a) [[1,-1],[-2,3]]
b) [[1,1],[2,3]]
c) [[-1,1],[2,-3]]
d) [[1,-1],[2,3]]

23. The rank of [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1
b) 2
c) 3

d) 0

24. If det(A)=4 and det(B)=3, det(AB) equals:

a) 7
b) 1
c) 12
d) 3/4

25. d/dx(a^x) equals (a constant):

a) a^x
b) $a^x \ln a$
c) $x \cdot a^{x-1}$
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26. $\int e^x dx$ equals:

a) e^x
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27. d/dx(tan x) equals:

a) $\sec^2 x$
b) $-\sec^2 x$
c) $\csc^2 x$
d) sec x

28. If A={1,2,3,4,5} and B={4,5,6,7}, the symmetric difference AΔB is:

a) {4,5}
b) {1,2,3,6,7}
c) {1,2,3,4,5,6,7}
d) { }

29. The derivative of $\ln(x^2+1)$ is:

a) $1/(x^2+1)$
b) $2x/(x^2+1)$
c) 2x
d) $x/(x^2+1)$

30. $\int_0^{\pi} \sin x \, dx$ equals:

a) 0
b) 1
c) 2
d) π

Answer Key

1-b 2-c 3-b 4-a 5-c 6-b 7-b 8-b 9-b 10-b 11-c 12-a 13-b 14-b 15-c 16-b 17-a 18-b 19-a 20-b 21-a 22-a 23-b 24-c 25-b 26-b 27-a 28-b 29-b 30-c

Mathematics — Solved Problem Bank

A set of fully worked problems spanning the whole subject, useful for a final confidence check before moving to the next part. Try each problem yourself before reading the solution.

Problem 1: Find the domain of f(x) = 1/(x-3).

Solution: *The function is undefined wherever the denominator is zero, i.e. $x = 3$. So the domain is all real numbers except 3: $x \in \mathbb{R}$, $x \neq 3$.*

Problem 2: Differentiate $y = (3x^2+1)^5$ using the chain rule.

Solution: *Let $u = 3x^2+1$, so $y = u^5$. $dy/du = 5u^4$, $du/dx = 6x$. By the chain rule, $dy/dx = 5u^4 \cdot 6x = 30x(3x^2+1)^4$.*

Problem 3: Evaluate $\int(2x + 3)dx$ from x=0 to x=2.

Solution: *The antiderivative is $x^2 + 3x$. Evaluating: $(2^2 + 3\cdot2) - (0 + 0) = (4+6) - 0 = 10$.*

Problem 4: Find the equation of the tangent line to $y = x^2$ at x = 2.

Solution: *$y' = 2x$, so the slope at $x=2$ is 4. The point is (2,4). Using point-slope form: $y - 4 = 4(x-2)$, i.e. $y = 4x - 4$.*

Problem 5: Solve the system: 2x + y = 7, x − y = 2.

Solution: *Adding the equations eliminates y: $3x = 9$, so $x = 3$. Substituting into $x - y = 2$ gives $y = 1$. Solution: $x=3$, $y=1$.*

Problem 6: Find the determinant of [[1,2,3],[0,1,4],[5,6,0]] by cofactor expansion along the first row.

Solution: *$\det = 1\cdot(1\cdot0-4\cdot6) - 2\cdot(0\cdot0-4\cdot5) + 3\cdot(0\cdot6-1\cdot5) = 1\cdot(-24) - 2\cdot(-20) + 3\cdot(-5) = -24+40-15 = 1$.*

Problem 7: A ball is thrown so its height is $h(t) = -5t^2 + 20t$. Find the maximum height.

Solution: *$h'(t) = -10t+20 = 0 \rightarrow t=2$. $h''(t)=-10<0$ confirms a maximum. $h(2) = -20+40 = 20$ (metres).*

Problem 8: Simplify $\log_2 32 - \log_2 4$.

Solution: *Using the quotient rule, this equals $\log_2(32/4) = \log_2 8 = 3$.*

Problem 9: Find the inverse of f(x) = (x+1)/2.

Solution: *Set $y=(x+1)/2$, solve for x: $2y = x+1$, so $x = 2y-1$. Thus $f^{-1}(x) = 2x-1$.*

Problem 10: Evaluate the limit $\lim_{x\to1} (x^3-1)/(x-1)$.

Solution: *Factor the numerator: $x^3-1 = (x-1)(x^2+x+1)$. Cancel $(x-1)$: the limit becomes x^2+x+1 at $x=1$, which is $1+1+1 = 3$.*

Problem 11: Find the eigenvalues of A = [[5,4],[1,2]].

Solution: *Solve $\det(A-\lambda I)=0$: $(5-\lambda)(2-\lambda) - 4 = 0 \rightarrow \lambda^2 -7\lambda+10-4=0 \rightarrow \lambda^2-7\lambda+6=0 \rightarrow (\lambda-1)(\lambda-6)=0$, so $\lambda=1$ or $\lambda=6$.*

Problem 12: A rectangle has perimeter 40. Find its dimensions for maximum area.

Solution: *Let sides be x and 20−x (since 2x+2y=40 → y=20−x). Area A = x(20−x) = 20x−x². A'=20−2x=0 → x=10, so y=10 also — a square of side 10 gives the maximum area of 100.*

Problem 13: Evaluate ∫₀^(π/2) cos x dx.

Solution: *The antiderivative of cos x is sin x. Evaluating: sin(π/2) − sin(0) = 1 − 0 = 1.*

Problem 14: Solve $2^x = 16$.

Solution: *Rewrite 16 as 2^4, so $2^x = 2^4$, giving x = 4 by matching exponents (since the base is the same).*

Problem 15: Find the rank of the matrix [[2,4],[1,2]].

Solution: *Row 2 (1,2) is exactly half of Row 1 (2,4), so the rows are linearly dependent — the rank is 1, not 2.*

Problem 16: Differentiate $y = x^2\sin(x)$ using the product rule.

Solution: *Let $u=x^2$, $v=\sin(x)$. $u'=2x$, $v'=\cos(x)$. By the product rule, $dy/dx = u'v + uv' = 2x\cdot\sin(x) + x^2\cdot\cos(x)$.*

Problem 17: Solve the inequality $2x - 5 > 3$.

Solution: *Add 5 to both sides: $2x > 8$. Divide by 2: $x > 4$.*

Problem 18: Find the sum of the first 10 terms of the arithmetic series 3, 7, 11, ...

Solution: *First term a=3, common difference d=4. Sum formula: $S_n = n/2[2a+(n-1)d] = 5[6+9\times4] = 5\times42 = 210$.*

Problem 19: Find $\int x\cdot e^x\,dx$ using integration by parts.

Solution: *Integration by parts: $\int u\,dv = uv - \int v\,du$. Let $u=x$, $dv=e^x dx$, so $du=dx$, $v=e^x$. Result: $xe^x - \int e^x dx = xe^x - e^x + C$.*

Problem 20: Determine whether $f(x) = x^3$ is odd, even, or neither.

Solution: *$f(-x) = (-x)^3 = -x^3 = -f(x)$, so f is odd — its graph is symmetric about the origin.*

Problem 21: Find the vertex of the parabola $y = 2x^2 - 8x + 3$.

Solution: *The vertex x-coordinate is $-b/2a = 8/4 = 2$. $y(2) = 2(4)-16+3 = 8-16+3 = -5$. Vertex: (2, −5).*

Problem 22: Solve for x: $3^{x+1} = 27$.

Solution: *$27 = 3^3$, so $3^{x+1} = 3^3$ gives $x+1 = 3$, so $x = 2$.*

Problem 23: Find d^2y/dx^2 for $y = x^4 - 3x^2$.

Solution: *First derivative: $4x^3 - 6x$. Second derivative: $12x^2 - 6$.*

Problem 24: A 3×3 matrix has two identical columns. What is its determinant?

Solution: *Whenever two rows or columns of a matrix are identical, the determinant is always 0, since the matrix is not full rank.*

Problem 25: Find the sum of the interior angles formula application: a hexagon has 6 sides. What is the sum of its interior angles?

Solution: *The formula is (n-2)×180°. For n=6: (6-2)×180 = 4×180 = 720°.*

Problem 26: Simplify $(x^2-9)/(x-3)$.

Solution: *Factor the numerator as a difference of squares: $(x-3)(x+3)/(x-3)$. Cancel $(x-3)$ for $x \neq 3$, leaving $x+3$.*

Problem 27: Find the slope of the line through (1,2) and (4,11).

Solution: *Slope = $(y2-y1)/(x2-x1) = (11-2)/(4-1) = 9/3 = 3$.*

Problem 28: Evaluate 5C2 (combinations of 5 items taken 2 at a time).

Solution: *$5C2 = 5!/(2!3!) = (5\times4)/(2\times1) = 10$.*

Problem 29: Solve $|x-3| = 5$.

Solution: *This splits into two cases: $x-3=5$ giving $x=8$, or $x-3=-5$ giving $x=-2$. Solutions: $x=8$ or $x=-2$.*

Problem 30: Find the sum to infinity of the geometric series $1 + 1/2 + 1/4 + ...$

Solution: *Sum to infinity = $a/(1-r) = 1/(1-0.5) = 1/0.5 = 2$.*

Problem 31: Differentiate $y = (2x+1)/(x-3)$ using the quotient rule.

Solution: *$u=2x+1$, $v=x-3$. $u'=2$, $v'=1$. $dy/dx = (u'v-uv')/v^2 = [2(x-3)-(2x+1)(1)]/(x-3)^2 = (2x-6-2x-1)/(x-3)^2 = -7/(x-3)^2$.*

Problem 32: Find the area of a triangle with vertices (0,0), (4,0), (0,3) using the determinant formula.

Solution: *Area = $1/2|x1(y2-y3)+x2(y3-y1)+x3(y1-y2)| = 1/2|0(0-3)+4(3-0)+0(0-0)| = 1/2|12| = 6$.*

Problem 33: Solve the equation $\sqrt{(x+2)} = 3$.

Solution: *Square both sides: $x+2 = 9$, so $x = 7$. Check: $\sqrt{9}=3$ ✓.*

Problem 34: Find the 5th term of the arithmetic sequence with a=2, d=3.

Solution: *$a_n = a + (n-1)d$. $a_5 = 2 + 4(3) = 2+12 = 14$.*

Mathematics — Glossary of Key Terms

A quick-reference glossary. Read through it once, then use it to test yourself: cover the definitions and try to recall each one from the term alone.

Term	Definition
Asymptote	A line that a curve approaches but never touches as it extends to infinity.
Bijection	A function that is both injective (one-to-one) and surjective (onto), and therefore invertible.
Cofactor	The signed minor of a matrix element, used in determinant expansion and finding inverses.
Discriminant	The expression b^2-4ac in a quadratic, which determines the nature of its roots.
Domain	The complete set of possible input values for a function.
Eigenvector	A non-zero vector whose direction is unchanged (only scaled) by a given linear transformation.
Gradient	A vector of partial derivatives pointing in the direction of steepest increase of a function.
Identity Matrix	A square matrix with 1's on the diagonal and 0's elsewhere; the multiplicative identity for matrices.
Integral	The reverse operation of differentiation; also represents accumulated area under a curve.
Limit	The value a function approaches as its input approaches some point.
Logarithm	The inverse operation of exponentiation; $\log_a x$ answers 'to what power must a be raised to get x?'
Matrix	A rectangular array of numbers arranged in rows and columns.
Partial Derivative	The derivative of a multivariable function with respect to one variable, holding others constant.
Quadratic Formula	The formula $x = [-b \pm \sqrt{(b^2-4ac)}]/2a$ used to solve $ax^2+bx+c=0$.
Range (of a function)	The actual set of output values a function produces.
Rank	The number of linearly independent rows (or columns) of a matrix.
Scalar	A single number, as opposed to a vector or matrix.
Set	A well-defined collection of distinct objects.
Tangent Line	A straight line that touches a curve at a point and has the same slope as the curve there.
Vector Space	A collection of vectors closed under addition and scalar multiplication, satisfying specific axioms.
Continuity	A property of a function having no breaks, jumps, or holes at a given point or over an interval.
Determinant	A scalar value computed from a square matrix, indicating invertibility and scaling factor of area/volume.
Even Function	A function satisfying $f(-x)=f(x)$, symmetric about the y-axis.
Odd Function	A function satisfying $f(-x)=-f(x)$, symmetric about the origin.
Power Set	The set of all possible subsets of a given set, including the empty set and the set itself.
Transpose	The matrix obtained by swapping a matrix's rows and columns.
Arithmetic Sequence	A sequence where each term differs from the previous by a constant amount (the common difference).
Geometric Sequence	A sequence where each term is a constant multiple (common ratio) of the previous term.
Combination	A selection of items from a group where order does not matter.
Permutation	An arrangement of items where order matters.
Slope	A measure of the steepness of a line, calculated as the change in y over the change in x.

PART 2

Statistics

Statistics carries 25 of the 100 marks and is the section most directly relevant to a Data Science degree — expect it to reward genuine conceptual understanding over rote memorization. This part covers descriptive statistics, probability, distributions, sampling, inference, and regression, organized week by week to match the study plan.

Wherever a formula appears, don't just memorize it — understand what real-world question it's answering. Examiners frequently test whether you know *when* to use a test or distribution, not just its formula.

This part is organized as 10 weeks of 6 study days each (60 days total), matching a Monday-to-Saturday study rhythm with Sunday reserved for mixed review across all five subjects (see Part 6).

Week 1: Types of Data, Mean, Median, Mode, Variance & Standard Deviation

Use this log to track your Statistics study sessions for Week 1. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Types of Data

Types of Data

Data is broadly qualitative (categorical) or quantitative (numerical). Qualitative data splits into nominal (unordered categories, e.g. blood group) and ordinal (ordered categories, e.g. satisfaction rating). Quantitative data splits into discrete (countable, e.g. number of children) and continuous (measurable, e.g. height).

Variance and Standard Deviation

The sum of squared deviations from the mean is always the minimum possible compared to deviations measured from any other point — this is why the mean, not the median, is used as the basis for variance.

Additional Practice Example: A dataset is 4, 8, 6, 5, 3, 7. Find the mean.
Solution: *Sum = 4+8+6+5+3+7 = 33. Mean = 33/6 = 5.5.*

Day 1 Quiz

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. The sum of squares of deviations is least when measured from the:
a) arithmetic mean
b) geometric mean
c) median
d) mode

3. An outlier is a data point that:
a) Equals the mean exactly
b) Is far from most other observations
c) Is always an error
d) Is the median

Answer Key

1-a 2-a 3-b

Day 2 — Types of Data

Types of Data

A finer classification uses four measurement scales: nominal (labels only), ordinal (labels with order), interval (ordered, equal spacing, no true zero — e.g. temperature in °C), and ratio (ordered, equal spacing, true zero — e.g. weight, income).

Additional Practice Example: Find the median of the dataset 12, 7, 9, 15, 3.
Solution: *Sort the data: 3, 7, 9, 12, 15. With 5 values, the median is the middle (3rd) value: 9.*

Day 2 Quiz

1. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

2. For skewed data with outliers, which is the best measure of central tendency?
a) Mean
b) Median
c) Mode
d) Range

3. A dataset with a single most-frequent value is called:
a) Bimodal
b) Unimodal
c) Multimodal
d) Non-modal

Answer Key

1-a 2-b 3-b

Day 3 — Measures of Central Tendency

Measures of Central Tendency

The arithmetic mean is the sum of values divided by their count: $\bar{x} = (\Sigma x_i)/n$. It uses every data point but is sensitive to outliers. The median is the middle value when data is sorted (average of the two middle values if n is even); it is robust to outliers and skewed data. The mode is the most frequently occurring value; a dataset can have zero, one, or several modes.

Additional Practice Example: A coin is tossed 3 times. Find the probability of getting exactly 2 heads (Binomial).
Solution: *$P(X=2) = C(3,2)(0.5)^2(0.5)^1 = 3 \times 0.25 \times 0.5 = 0.375$.*

Day 3 Quiz

1. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

2. A dataset can have how many modes?
a) Exactly one
b) Zero, one, or more
c) Always zero
d) Always equal to n

3. An interval scale has a true zero point?
a) Yes always
b) No
c) Only sometimes
d) Only for temperature

Answer Key

1-c 2-b 3-b

Day 4 — Measures of Central Tendency

Measures of Central Tendency

Rule of thumb: for symmetric, outlier-free data, mean and median are close and either works. For skewed data (e.g. income), the median better represents a 'typical' value.

Additional Practice Example: A die is rolled. Find P(even number OR number greater than 4).
Solution: *Even = {2,4,6}, >4 = {5,6}. Union = {2,4,5,6}, so P = 4/6 = 2/3.*

Day 4 Quiz

1. Sample variance uses a denominator of:
a) n
b) n-1
c) n+1
d) n^2

2. Bessel's correction (n-1) is used to make sample variance:
a) Larger than population variance always
b) An unbiased estimator of population variance
c) Equal to standard deviation
d) Always positive

3. The most common average for nominal data is the:
a) Mean
b) Median
c) Mode
d) Geometric mean

Answer Key

1-b 2-b 3-c

Day 5 — Variance and Standard Deviation

Variance and Standard Deviation

Variance measures average squared deviation from the mean: population variance $\sigma^2 = \Sigma(x_i-\mu)^2/N$; sample variance $s^2 = \Sigma(x_i-\bar{x})^2/(n-1)$ — note the $(n-1)$ 'Bessel's correction' used for samples, which makes s^2 an unbiased estimator of σ^2.

Additional Practice Example: If $E(X)=10$ and $Var(X)=9$, find $E(X^2)$.
Solution: *$Var(X) = E(X^2) - [E(X)]^2$, so $E(X^2) = Var(X) + [E(X)]^2 = 9 + 100 = 109$.*

Day 5 Quiz

1. The sum of deviations of data values is always zero when measured from the:
a) arithmetic mean
b) geometric mean
c) median
d) mode

2. A census differs from a sample survey because a census covers:
a) A small random subset
b) The entire population
c) Only males
d) Only urban areas

Answer Key

1-a 2-b

Day 6 — Variance and Standard Deviation

Variance and Standard Deviation

Standard deviation is the square root of variance, $\sigma = \sqrt{\sigma^2}$, bringing the units back to the original scale (unlike variance, which is in squared units). A small standard deviation means data clusters tightly around the mean; a large one means it's spread out.

Additional Practice Example: Find the standard deviation of the dataset 2, 4, 4, 4, 5, 5, 7, 9 (population).
Solution: *Mean = 40/8 = 5. Squared deviations: 9,1,1,1,0,0,4,16, sum=32. Variance = 32/8 = 4. Standard deviation = √4 = 2.*

Day 6 Quiz

1. Temperature in Celsius is an example of which measurement scale?
a) Nominal
b) Ordinal
c) Interval
d) Ratio

2. The mode is best used for:
a) Continuous numeric data only
b) Categorical data
c) Highly precise measurements
d) Data with no repeats

Answer Key

1-c 2-b

Week 1 Mock Test

Two short tests to close out Week 1: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 1 Only

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. Sample variance uses a denominator of:
a) n
b) n-1
c) n+1
d) n^2

5. The sum of deviations of data values is always zero when measured from the:
a) arithmetic mean
b) geometric mean
c) median
d) mode

6. Temperature in Celsius is an example of which measurement scale?
a) Nominal
b) Ordinal
c) Interval
d) Ratio

7. The sum of squares of deviations is least when measured from the:
a) arithmetic mean
b) geometric mean
c) median

d) mode

8. For skewed data with outliers, which is the best measure of central tendency?
a) Mean
b) Median
c) Mode
d) Range

9. A dataset can have how many modes?
a) Exactly one
b) Zero, one, or more
c) Always zero
d) Always equal to n

10. Bessel's correction (n-1) is used to make sample variance:
a) Larger than population variance always
b) An unbiased estimator of population variance
c) Equal to standard deviation
d) Always positive

11. A census differs from a sample survey because a census covers:
a) A small random subset
b) The entire population
c) Only males
d) Only urban areas

12. The mode is best used for:
a) Continuous numeric data only
b) Categorical data
c) Highly precise measurements
d) Data with no repeats

13. An outlier is a data point that:
a) Equals the mean exactly
b) Is far from most other observations
c) Is always an error
d) Is the median

14. A dataset with a single most-frequent value is called:
a) Bimodal
b) Unimodal
c) Multimodal
d) Non-modal

15. An interval scale has a true zero point?
a) Yes always
b) No
c) Only sometimes
d) Only for temperature

16. The most common average for nominal data is the:
a) Mean
b) Median
c) Mode
d) Geometric mean

Answer Key

1-a 2-a 3-c 4-b 5-a 6-c 7-a 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-b 16-c

Part B — Cumulative, Weeks 1-1

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

Answer Key

1-a 2-a 3-c

Week 2: Probability, Conditional Probability & Bayes' Theorem

Use this log to track your Statistics study sessions for Week 2. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Basic Probability

Basic Probability

Probability quantifies the likelihood of an event, P(E) = (favorable outcomes)/(total outcomes), always between 0 and 1. For any event, $P(E^c) = 1 - P(E)$. For two events, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (avoids double-counting the overlap). If A and B are mutually exclusive, $P(A \cap B) = 0$, so $P(A \cup B) = P(A)+P(B)$.

Additional Practice Example: A sample of size 36 has mean 50 and σ=12. Find the standard error.

Solution: *Standard error = $\sigma/\sqrt{n} = 12/\sqrt{36} = 12/6 = 2$.*

Day 1 Quiz

1. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =

a) 0.9
b) 0.2
c) 0.1
d) 0.45

2. In Bayes' theorem, P(A|B) equals:

a) P(A)P(B)/P(A∩B)
b) P(B|A)P(A)/P(B)
c) P(A)/P(B)
d) P(A∩B)

3. If P(A|B)=P(A), then A and B are:

a) Mutually exclusive
b) Independent
c) Complementary
d) Identical events

Answer Key

1-b 2-b 3-b

Day 2 — Basic Probability

Basic Probability

Independence: A and B are independent if $P(A \cap B) = P(A) \cdot P(B)$ — knowing one occurred tells you nothing about the other.

Additional Practice Example: Two dice are rolled. Find P(sum = 7).
Solution: *There are 6 favorable outcomes out of 36 total: (1,6),(2,5),(3,4),(4,3),(5,2),(6,1). P = 6/36 = 1/6.*

Day 2 Quiz

1. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

2. Two events are independent if:
a) $P(A \cap B)=0$
b) $P(A \cap B)=P(A)+P(B)$
c) $P(A \cap B)=P(A)P(B)$
d) $P(A|B)=0$

3. $P(A \cap B)$ for independent events equals:
a) $P(A)+P(B)$
b) $P(A) \times P(B)$
c) $P(A)-P(B)$
d) $P(A)/P(B)$

Answer Key

1-b 2-c 3-b

Day 3 — Conditional Probability

Conditional Probability

Conditional probability $P(A|B) = P(A \cap B)/P(B)$ is the probability of A given that B has already occurred ($P(B) > 0$). Rearranged, this gives the multiplication rule: $P(A \cap B) = P(A|B) \cdot P(B)$.

Additional Practice Example: A Poisson process has $\lambda=4$ events/hour. Find the probability of exactly 0 events in an hour.
Solution: *$P(X=0) = e^{-4}(4^0)/0! = e^{-4} \approx 0.0183$.*

Day 3 Quiz

1. Conditional probability P(A|B) is defined as:
a) $P(A \cap B)/P(B)$
b) $P(A)P(B)$
c) $P(A \cup B)$
d) $P(B)/P(A)$

2. $P(E^c)$, the complement of event E, equals:
a) P(E)
b) 1-P(E)
c) 1+P(E)
d) 0

3. A Venn diagram is most useful for visualizing:
a) Regression lines
b) Set/event overlaps
c) Time series trends
d) Histograms

Answer Key

1-a 2-b 3-b

Day 4 — Conditional Probability

Conditional Probability

Worked Example: In a class, 60% of students are female, and 30% of females study Statistics. The probability a randomly chosen student is female AND studies Statistics is P(Female ∩ Stats) = 0.30 × 0.60 = 0.18.

Additional Practice Example: Compute a 90% confidence interval for μ if $\bar{x}$=100, σ=15, n=25 (Z=1.645).
Solution: *CI = 100 ± 1.645×(15/√25) = 100 ± 1.645×3 = 100 ± 4.935 = (95.065, 104.935).*

Day 4 Quiz

1. The probability of a sure event is:
a) 0
b) 1
c) 0.2
d) 0.5

2. The Naive Bayes classifier in machine learning is based on:
a) Linear regression
b) Bayes' theorem with an independence assumption
c) Gradient descent
d) Eigenvalue decomposition

3. The complement rule states $P(A^c)$ equals:
a) P(A)
b) 1-P(A)
c) 1+P(A)
d) 0

Answer Key

1-b 2-b 3-b

Day 5 — Bayes' Theorem

Bayes' Theorem

Bayes' theorem lets you reverse a conditional probability: P(A|B) = [P(B|A)·P(A)] / P(B). It is the mathematical basis of many classification algorithms (e.g. Naive Bayes) and medical/diagnostic testing, where you know P(positive test | disease) but actually want P(disease | positive test).

Additional Practice Example: Find the variance of a Binomial(n=50, p=0.2).
Solution: *Variance = $np(1-p) = 50 \times 0.2 \times 0.8 = 8$.*

Day 5 Quiz

1. If A and B are mutually exclusive, P(A∩B) =
a) 1
b) P(A)P(B)
c) 0
d) P(A)+P(B)

2. Mutually exclusive and exhaustive events must sum their probabilities to:
a) 0
b) 0.5
c) 1
d) Depends on the events

Answer Key

1-c 2-c

Day 6 — Bayes' Theorem

Bayes' Theorem

Worked Example: A disease affects 1% of a population. A test is 99% accurate for both sick and healthy people (99% true positive, 99% true negative). Given a positive test, P(disease|positive) = (0.99×0.01) / (0.99×0.01 + 0.01×0.99) = 0.0099/0.0198 = 0.5 — perhaps surprisingly, only 50%, because false positives among the large healthy population still outnumber true positives from the rare disease.

Additional Practice Example: A correlation study finds r=0.6. What percentage of variance in Y is explained by X?
Solution: *$R^2 = r^2 = 0.36$, so 36% of the variance in Y is explained by X.*

Day 6 Quiz

1. P(A∪B) is generally computed as:
a) P(A)+P(B)
b) P(A)+P(B)-P(A∩B)
c) P(A)×P(B)
d) P(A)-P(B)

2. A probability tree diagram is most useful for:
a) Calculating means
b) Visualizing sequential conditional events
c) Finding variance only
d) Plotting histograms

Answer Key

1-b 2-b

Week 2 Mock Test

Two short tests to close out Week 2: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 2 Only

1. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

2. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

3. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

4. The probability of a sure event is:
a) 0
b) 1
c) 0.2
d) 0.5

5. If A and B are mutually exclusive, P(A∩B) =
a) 1
b) P(A)P(B)
c) 0
d) P(A)+P(B)

6. P(A∪B) is generally computed as:
a) P(A)+P(B)
b) P(A)+P(B)-P(A∩B)
c) P(A)×P(B)
d) P(A)-P(B)

7. In Bayes' theorem, P(A|B) equals:
a) P(A)P(B)/P(A∩B)
b) P(B|A)P(A)/P(B)
c) P(A)/P(B)

d) $P(A \cap B)$

8. Two events are independent if:
a) $P(A \cap B)=0$
b) $P(A \cap B)=P(A)+P(B)$
c) $P(A \cap B)=P(A)P(B)$
d) $P(A|B)=0$

9. $P(E^c)$, the complement of event E, equals:
a) P(E)
b) 1-P(E)
c) 1+P(E)
d) 0

10. The Naive Bayes classifier in machine learning is based on:
a) Linear regression
b) Bayes' theorem with an independence assumption
c) Gradient descent
d) Eigenvalue decomposition

11. Mutually exclusive and exhaustive events must sum their probabilities to:
a) 0
b) 0.5
c) 1
d) Depends on the events

12. A probability tree diagram is most useful for:
a) Calculating means
b) Visualizing sequential conditional events
c) Finding variance only
d) Plotting histograms

13. If $P(A|B)=P(A)$, then A and B are:
a) Mutually exclusive
b) Independent
c) Complementary
d) Identical events

14. $P(A \cap B)$ for independent events equals:
a) $P(A)+P(B)$
b) $P(A) \times P(B)$
c) $P(A)-P(B)$
d) $P(A)/P(B)$

15. A Venn diagram is most useful for visualizing:
a) Regression lines
b) Set/event overlaps
c) Time series trends
d) Histograms

16. The complement rule states $P(A^c)$ equals:
a) P(A)
b) 1-P(A)
c) 1+P(A)
d) 0

Answer Key

1-b 2-b 3-a 4-b 5-c 6-b 7-b 8-c 9-b 10-b 11-c 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-2

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, $P(A \cap B)$ =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) $P(A \cap B)/P(B)$
b) P(A)P(B)
c) $P(A \cup B)$
d) P(B)/P(A)

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a

Week 3: Random Variables & Probability Distributions

Use this log to track your Statistics study sessions for Week 3. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Random Variables

Random Variables

A random variable (RV) assigns a numeric value to each outcome of a random experiment. A discrete RV takes countable values (e.g. number of heads in 3 coin tosses); a continuous RV takes any value in a range (e.g. height).

Additional Practice Example: Test H_0: $\mu=50$ vs H_1: $\mu\neq50$ with $\bar{x}=53$, $\sigma=6$, $n=36$. Find the Z statistic.

Solution: *$Z = (\bar{x}-\mu)/(\sigma/\sqrt{n}) = (53-50)/(6/6) = 3/1 = 3$.*

Day 1 Quiz

1. A random variable that takes countable values is called:

a) Continuous
b) Discrete
c) Uniform
d) Normal

2. A probability density function (PDF) integrates over its entire range to:

a) 0
b) 0.5
c) 1
d) infinity

3. Var(aX+b) for constants a,b equals:

a) aVar(X)+b
b) a^2Var(X)
c) Var(X)+b^2
d) a^2Var(X)+b

Answer Key

1-b 2-c 3-b

Day 2 — Random Variables

Random Variables

For a discrete RV, the probability mass function (PMF) gives P(X=x) for each possible value, and these probabilities sum to 1. For a continuous RV, the probability density function (PDF) f(x) satisfies $\int f(x)dx = 1$ over its range, and probabilities are areas under the curve — P(X=exact value) is always 0 for continuous RVs.

Additional Practice Example: A quality control process finds 2 defective items in a sample of 100 ($\hat{p}$=0.02). If the true defect rate is thought to be 5%, is 2% notably lower?

Solution: *This requires a hypothesis test for a proportion; conceptually, since 0.02 is meaningfully below 0.05, a Z-test for proportions would likely reject H_0: p=0.05 in favor of a lower true rate, pending the actual computed p-value.*

Day 2 Quiz

1. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

2. If E(X)=2 and $E(X^2)$=20, the standard deviation of X is:
a) 2
b) 3
c) 4
d) 16

3. A PMF must always be:
a) Negative for some values
b) Non-negative and sum to 1
c) Equal to 1 for every value
d) Undefined at 0

Answer Key

1-c 2-c 3-b

Day 3 — Expectation and Variance of a Random Variable

Expectation and Variance of a Random Variable

The expected value (mean) of a discrete RV is $E(X) = \Sigma x \cdot P(X=x)$. Variance is $Var(X) = E(X^2) - [E(X)]^2$, where $E(X^2) = \Sigma x^2 \cdot P(X=x)$. Standard deviation is $\sqrt{Var(X)}$.

Additional Practice Example: Find $P(X<1)$ for a discrete RV with $P(X=0)=0.3$, $P(X=1)=0.4$, $P(X=2)=0.3$.
Solution: *$P(X<1)$ means strictly less than 1, so only $X=0$ qualifies: $P(X<1) = 0.3$.*

Day 3 Quiz

1. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

2. The probability mass function (PMF) applies to:
a) Continuous random variables only
b) Discrete random variables
c) Neither
d) Both equally by definition

3. E(constant c) for any constant equals:
a) 0
b) 1
c) c
d) undefined

Answer Key
1-b 2-b 3-c

Day 4 — Expectation and Variance of a Random Variable

Expectation and Variance of a Random Variable

Worked Example: X takes values 0,1,2 with probabilities 0.5, 0.3, 0.2. E(X) = $0(0.5)+1(0.3)+2(0.2) = 0.7$. $E(X^2) = 0+0.3+0.8 = 1.1$. $Var(X) = 1.1 - 0.49 = 0.61$.

Additional Practice Example: A bag has 5 red and 3 blue balls. Find P(drawing a red ball).
Solution: *Total balls = 8, red = 5. P(red) = 5/8.*

Day 4 Quiz

1. For a continuous random variable, P(X = a specific value) is:
a) 1
b) 0.5
c) 0
d) undefined

2. Which of these could NOT be a valid probability value?
a) 0
b) 0.5
c) 1
d) 1.5

3. Var(constant c) always equals:
a) c
b) c^2
c) 1
d) 0

Answer Key

1-c 2-d 3-d

Day 5 — Common Distributions Overview

Common Distributions Overview

This week's focus is understanding what a 'probability distribution' fundamentally is — a rule assigning probabilities to all possible outcomes. Next week digs into the three most testable named distributions: Binomial, Poisson, and Normal. For now, be comfortable computing E(X) and Var(X) for any given PMF from scratch, since this underlies every named distribution's formulas.

Additional Practice Example: Two independent events have P(A)=0.3 and P(B)=0.6. Find P(A or B).

Solution: $P(A \cup B) = P(A)+P(B)-P(A)P(B) = 0.3+0.6-0.18 = 0.72.$

Day 5 Quiz

1. If X takes values 0,1,2,3,4 with probabilities 0.6,0.1,0.1,0.1,0.1, the mean of X is:

a) 0.1
b) 1.0
c) 0.5
d) 2

2. A cumulative distribution function (CDF) gives:

a) P(X=x) exactly
b) P(X≤x)
c) The mode only
d) The variance

Answer Key

1-b 2-b

Day 6 — Random Variables (Review)

Random Variables

A random variable (RV) assigns a numeric value to each outcome of a random experiment. A discrete RV takes countable values (e.g. number of heads in 3 coin tosses); a continuous RV takes any value in a range (e.g. height).

Additional Practice Example: A sample has values 10, 12, 14, 16, 18. Find the range and the mean.

Solution: *Range = max−min = 18−10 = 8. Mean = (10+12+14+16+18)/5 = 70/5 = 14.*

Day 6 Quiz

1. The variance formula Var(X) equals:

a) E(X)
b) $E(X^2)-[E(X)]^2$
c) $[E(X)]^2$
d) $E(X^2)+[E(X)]^2$

2. For a discrete uniform distribution over {1,...,6} (a fair die), the mean is:

a) 3
b) 3.5
c) 4
d) 6

Answer Key

1-b 2-b

Week 3 Mock Test

Two short tests to close out Week 3: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 3 Only

1. A random variable that takes countable values is called:
a) Continuous
b) Discrete
c) Uniform
d) Normal

2. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

3. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

4. For a continuous random variable, P(X = a specific value) is:
a) 1
b) 0.5
c) 0
d) undefined

5. If X takes values 0,1,2,3,4 with probabilities 0.6,0.1,0.1,0.1,0.1, the mean of X is:
a) 0.1
b) 1.0
c) 0.5
d) 2

6. The variance formula Var(X) equals:
a) E(X)
b) $E(X^2)-[E(X)]^2$
c) $[E(X)]^2$
d) $E(X^2)+[E(X)]^2$

7. A probability density function (PDF) integrates over its entire range to:
a) 0
b) 0.5
c) 1

d) infinity

8. If $E(X)=2$ and $E(X^2)=20$, the standard deviation of X is:
a) 2
b) 3
c) 4
d) 16

9. The probability mass function (PMF) applies to:
a) Continuous random variables only
b) Discrete random variables
c) Neither
d) Both equally by definition

10. Which of these could NOT be a valid probability value?
a) 0
b) 0.5
c) 1
d) 1.5

11. A cumulative distribution function (CDF) gives:
a) $P(X=x)$ exactly
b) $P(X\leq x)$
c) The mode only
d) The variance

12. For a discrete uniform distribution over $\{1,...,6\}$ (a fair die), the mean is:
a) 3
b) 3.5
c) 4
d) 6

13. $Var(aX+b)$ for constants a,b equals:
a) $aVar(X)+b$
b) $a^2Var(X)$
c) $Var(X)+b^2$
d) $a^2Var(X)+b$

14. A PMF must always be:
a) Negative for some values
b) Non-negative and sum to 1
c) Equal to 1 for every value
d) Undefined at 0

15. E(constant c) for any constant equals:
a) 0
b) 1
c) c
d) undefined

16. Var(constant c) always equals:
a) c
b) c^2
c) 1
d) 0

Answer Key

1-b 2-c 3-b 4-c 5-b 6-b 7-c 8-c 9-b 10-d 11-b 12-b 13-b 14-b 15-c 16-d

Part B — Cumulative, Weeks 1-3

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:
a) Continuous

b) Discrete
c) Uniform
d) Normal

8. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b

Week 4: Binomial, Poisson & Normal Distributions

Use this log to track your Statistics study sessions for Week 4. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Binomial Distribution

Binomial Distribution

Models the number of successes in n independent trials, each with success probability p. PMF: $P(X=x) = C(n,x)p^x(1-p)^{n-x}$. Mean = np, Variance = np(1−p). Used when there are exactly two outcomes per trial (success/failure) and trials are independent with constant p.

Additional Practice Example: If a Poisson variable has mean 3, find P(X=2).
Solution: *$P(X=2) = e^{-3}(3^2)/2! = e^{-3}\times 9/2 \approx 0.0498\times 4.5 \approx 0.224$.*

Day 1 Quiz

1. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

2. The standard normal distribution has mean and variance:
a) 0 and 1
b) 1 and 0
c) 0 and 0
d) 1 and 1

3. The mode of a normal distribution is located at:
a) One standard deviation from the mean
b) The mean
c) The median only, not the mean
d) Undefined

Answer Key

1-a 2-a 3-b

Day 2 — Binomial Distribution

Binomial Distribution

Note: since $(1-p) < 1$, variance $(np(1-p))$ is always strictly less than the mean (np) for $0<p<1$ — a fact often tested directly.

Additional Practice Example: A normal variable has $\mu=50$, $\sigma=10$. Find the Z-score for $X=65$.
Solution: *$Z = (X-\mu)/\sigma = (65-50)/10 = 1.5$.*

Day 2 Quiz

1. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

2. The Z-transformation for $X \sim N(\mu,\sigma^2)$ is:
a) $Z=(X-\mu)/\sigma$
b) $Z=(X+\mu)/\sigma$
c) $Z=X\sigma-\mu$
d) $Z=\mu/X$

3. For Binomial(n,p), as $p \to 0.5$ with n fixed, the distribution becomes more:
a) Skewed
b) Symmetric
c) Undefined
d) Bimodal always

Answer Key

1-b 2-a 3-b

Day 3 — Poisson Distribution

Poisson Distribution

Models the number of events occurring in a fixed interval of time or space, when events happen independently at a constant average rate λ. PMF: $P(X=x) = e^{-\lambda}\lambda^x/x!$. Mean = Variance = λ (a distinctive feature — mean and variance are equal). Commonly used for rare-event counts: number of customer arrivals per hour, number of typos per page, number of server failures per day.

Additional Practice Example: Find the coefficient of variation if mean=40 and s.d.=8.
Solution: *CV = (s.d./mean)×100 = (8/40)×100 = 20%.*

Day 3 Quiz

1. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

2. Approximately what % of normal data falls within 2 standard deviations of the mean?
a) 50%
b) 68%
c) 95%
d) 99.7%

3. A Poisson distribution's parameter λ represents:
a) The standard deviation
b) The mean rate of occurrence
c) The mode only
d) The sample size

Answer Key

1-b 2-c 3-b

Day 4 — Poisson Distribution

Poisson Distribution

The Poisson distribution is the limiting case of the Binomial when $n \to \infty$, $p \to 0$, and $np \to \lambda$ (finite) — useful when n is large but p is small.

Additional Practice Example: A regression line is $\hat{y} = 5 + 2x$. Predict y when x=10.
Solution: *$\hat{y} = 5 + 2(10) = 5+20 = 25$.*

Day 4 Quiz

1. Which is true for a Binomial distribution?
a) Mean and variance are equal
b) Mean is greater than variance
c) Mean is less than variance
d) None of these

2. The PMF of a binomial distribution is:
a) $C(n,x)p^x(1-p)^{n-x}$
b) $e^{-\lambda}\lambda^x/x!$
c) $(1/\sigma\sqrt{2\pi})\exp(...)$
d) $np(1-p)$

3. For a standard normal distribution, $P(Z<0)$ equals:
a) 0
b) 0.5
c) 1
d) -0.5

Answer Key

1-b 2-a 3-b

Day 5 — Normal Distribution

Normal Distribution

The bell-shaped, symmetric distribution with PDF $f(x) = (1/(\sigma\sqrt{(2\pi)}))\cdot\exp(-(x-\mu)^2/2\sigma^2)$, fully described by its mean μ and standard deviation σ. For a normal distribution, mean = median = mode.

Additional Practice Example: In a class of 40, 25 passed Math and 20 passed Stats, with 15 passing both. Find P(passed Math or Stats).
Solution: *$P(M\cup S) = P(M)+P(S)-P(M\cap S) = 25/40+20/40-15/40 = 30/40 = 0.75$.*

Day 5 Quiz

1. For a Poisson distribution with parameter λ, the variance is:
a) λ^2
b) $\sqrt{\lambda}$
c) λ
d) 2λ

2. For a binomial distribution, as n increases with p fixed, the distribution's shape approaches:
a) Uniform
b) Normal (by CLT)
c) Exponential
d) Undefined

Answer Key

1-c 2-b

Day 6 — Normal Distribution

Normal Distribution

The Empirical (68-95-99.7) Rule: about 68% of data falls within 1 SD of the mean, 95% within 2 SD, and 99.7% within 3 SD. The standard normal distribution has μ=0, σ=1; any normal variable is converted to it via Z = (X−μ)/σ, which is essential for looking up probabilities in Z-tables and for hypothesis testing.

Additional Practice Example: A sample variance is 25 with n=16. Find the standard error of the mean.
Solution: *Standard error = s/√n = √25/√16 = 5/4 = 1.25.*

Day 6 Quiz

1. Binomial tends to Poisson when:
a) n→∞, p→0, np=λ(finite)
b) n→∞, p→1
c) n→0, p→0
d) n→15, p→1/2

2. A Poisson distribution requires events to occur:
a) Dependently
b) Independently at a constant average rate
c) In pairs only
d) Never simultaneously by definition alone

Answer Key

1-a 2-b

Week 4 Mock Test

Two short tests to close out Week 4: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 4 Only

1. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

2. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

3. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

4. Which is true for a Binomial distribution?
a) Mean and variance are equal
b) Mean is greater than variance
c) Mean is less than variance
d) None of these

5. For a Poisson distribution with parameter λ, the variance is:
a) λ^2
b) $\sqrt{\lambda}$
c) λ
d) 2λ

6. Binomial tends to Poisson when:
a) $n\to\infty$, $p\to 0$, $np=\lambda$(finite)
b) $n\to\infty$, $p\to 1$
c) $n\to 0$, $p\to 0$
d) $n\to 15$, $p\to 1/2$

7. The standard normal distribution has mean and variance:
a) 0 and 1
b) 1 and 0
c) 0 and 0

d) 1 and 1

8. The Z-transformation for $X \sim N(\mu,\sigma^2)$ is:
a) $Z=(X-\mu)/\sigma$
b) $Z=(X+\mu)/\sigma$
c) $Z=X\sigma-\mu$
d) $Z=\mu/X$

9. Approximately what % of normal data falls within 2 standard deviations of the mean?
a) 50%
b) 68%
c) 95%
d) 99.7%

10. The PMF of a binomial distribution is:
a) $C(n,x)p^x(1-p)^{n-x}$
b) $e^{-\lambda}\lambda^x/x!$
c) $(1/\sigma\sqrt{2\pi})\exp(...)$
d) $np(1-p)$

11. For a binomial distribution, as n increases with p fixed, the distribution's shape approaches:
a) Uniform
b) Normal (by CLT)
c) Exponential
d) Undefined

12. A Poisson distribution requires events to occur:
a) Dependently
b) Independently at a constant average rate
c) In pairs only
d) Never simultaneously by definition alone

13. The mode of a normal distribution is located at:
a) One standard deviation from the mean
b) The mean
c) The median only, not the mean
d) Undefined

14. For Binomial(n,p), as $p \to 0.5$ with n fixed, the distribution becomes more:
a) Skewed
b) Symmetric
c) Undefined
d) Bimodal always

15. A Poisson distribution's parameter λ represents:
a) The standard deviation
b) The mean rate of occurrence
c) The mode only
d) The sample size

16. For a standard normal distribution, P(Z<0) equals:
a) 0
b) 0.5
c) 1
d) -0.5

Answer Key

1-a 2-b 3-b 4-b 5-c 6-a 7-a 8-a 9-c 10-a 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-4

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:
a) Continuous

b) Discrete
c) Uniform
d) Normal

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a) 0
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d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

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a) np
b) np(1-p)
c) p/n
d) n/p

11. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

12. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b

Week 5: Sampling, Sampling Distributions & Central Limit Theorem

Use this log to track your Statistics study sessions for Week 5. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Sampling Basics

Sampling Basics

A population includes every unit of interest; a sample is a subset actually observed. Sampling can be with or without replacement — 'with replacement' means each draw is independent and identically distributed, which simplifies most formulas taught at this level. Random sampling (every unit having a known, non-zero chance of selection) is what makes statistical inference valid.

Additional Practice Example: A survey of 50 people finds 30 prefer tea. Find the sample proportion.
Solution: *$\hat{p} = 30/50 = 0.6$.*

Day 1 Quiz

1. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.

a) Uniform
b) Normal
c) Binomial
d) Poisson

2. A commonly used rule-of-thumb minimum sample size for CLT to apply well is:

a) $n \geq 5$
b) $n \geq 10$
c) $n \geq 30$
d) $n \geq 100$

3. The CLT is most useful because it lets us apply normal-based methods even when:

a) The sample size is tiny
b) The population distribution is unknown/non-normal
c) There is no data
d) The variance is zero

Answer Key

1-b 2-c 3-b

Day 2 — Sampling Basics

Sampling Basics

Worked Example: The number of possible samples of size 2 selected with replacement from a population of size 4 is 4×4 = 16 (order matters, repetition allowed).

Additional Practice Example: Find the interquartile range (IQR) if Q1=20 and Q3=35.
Solution: *IQR = Q3 - Q1 = 35 - 20 = 15.*

Day 2 Quiz

1. Sampling error decreases as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

2. The mean of the sampling distribution of the sample mean equals:
a) The sample mean of one sample only
b) The population mean
c) Zero always
d) The population variance

3. A larger sample generally makes the sampling distribution of the mean:
a) Wider
b) Narrower
c) Unchanged
d) Bimodal

Answer Key

1-b 2-b 3-b

Day 3 — Sampling Distributions

Sampling Distributions

A sampling distribution is the probability distribution of a statistic (e.g. the sample mean $\bar{x}$) computed over all possible samples of a given size. It is a distribution of statistics, not of individual data points — a subtle but frequently tested distinction.

Additional Practice Example: A dataset's z-score for a value is 2. What does this mean?
Solution: *The value lies 2 standard deviations above the mean.*

Day 3 Quiz

1. A sampling distribution is the probability distribution of a:
a) Population parameter
b) Statistic computed from samples
c) Single observation
d) Census

2. Random sampling ensures every unit has:
a) An equal chance only
b) A known, non-zero chance of selection
c) No chance of selection
d) A chance based on size only

3. Simple random sampling gives every unit:
a) An equal, known chance of selection
b) No chance of selection
c) Only a chance if wealthy
d) Selection based on order only

Answer Key

1-b 2-b 3-a

Day 4 — Sampling Distributions

Sampling Distributions

Sampling error is the natural difference between a sample statistic and the true population parameter, purely due to which particular sample was drawn (not due to bias). It shrinks as sample size n increases.

Additional Practice Example: If a fair die is rolled twice, find P(both rolls show 6).
Solution: *Each roll is independent with $P(6)=1/6$. $P(\text{both})=1/6\times1/6=1/36$.*

Day 4 Quiz

1. How many samples of size 2 can be drawn with replacement from a population of 4?
a) 6
b) 4
c) 16
d) 8

2. The CLT applies regardless of:
a) Sample size
b) The shape of the original population distribution
c) The sampling method
d) The mean of the population

3. The CLT works best/fastest when the underlying population is already:
a) Highly skewed
b) Roughly symmetric
c) Categorical
d) Unknown

Answer Key

1-c 2-b 3-b

Day 5 — Central Limit Theorem (CLT)

Central Limit Theorem (CLT)

The CLT states that the sampling distribution of the sample mean $\bar{x}$ approaches a Normal distribution as sample size n grows large (commonly $n \geq 30$ is used as a rule of thumb), regardless of the shape of the original population distribution. Its mean equals the population mean μ, and its standard deviation (the 'standard error') equals $\sigma/\sqrt{n}$.

Additional Practice Example: A company's revenue grew from 100 to 121 over 2 years. Find the annual growth rate (geometric mean approach).
Solution: *121/100 = 1.21 over 2 years, so annual factor = √1.21 = 1.1, meaning 10% annual growth.*

Day 5 Quiz

1. The standard error of the mean is given by:
a) σ
b) $\sigma/\sqrt{n}$
c) σ^2
d) σn

2. A larger sample size, holding variability constant, results in a sampling distribution that is:
a) More spread out
b) Less spread out (smaller standard error)
c) Unaffected
d) Bimodal

Answer Key

1-b 2-b

Day 6 — Central Limit Theorem (CLT)

Central Limit Theorem (CLT)

The CLT is the theoretical backbone that allows Z-tests, confidence intervals, and many hypothesis tests to use the normal distribution even when the underlying data isn't normal.

Additional Practice Example: Find the weighted mean of scores 80 (weight 2) and 90 (weight 3).
Solution: *Weighted mean = (80×2+90×3)/(2+3) = (160+270)/5 = 430/5 = 86.*

Day 6 Quiz

1. As per the CLT, this normal approximation improves as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) Standard deviation increases

2. Systematic sampling selects units:
a) Purely randomly with no pattern
b) At regular intervals from a list
c) Only from convenient sources
d) By stratifying first always

Answer Key

1-b 2-b

Week 5 Mock Test

Two short tests to close out Week 5: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 5 Only

1. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.

a) Uniform
b) Normal
c) Binomial
d) Poisson

2. Sampling error decreases as:

a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

3. A sampling distribution is the probability distribution of a:

a) Population parameter
b) Statistic computed from samples
c) Single observation
d) Census

4. How many samples of size 2 can be drawn with replacement from a population of 4?

a) 6
b) 4
c) 16
d) 8

5. The standard error of the mean is given by:

a) σ
b) $\sigma/\sqrt{n}$
c) σ^2
d) σn

6. As per the CLT, this normal approximation improves as:

a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) Standard deviation increases

7. A commonly used rule-of-thumb minimum sample size for CLT to apply well is:

a) $n \geq 5$
b) $n \geq 10$

c) $n \geq 30$
d) $n \geq 100$

8. The mean of the sampling distribution of the sample mean equals:
a) The sample mean of one sample only
b) The population mean
c) Zero always
d) The population variance

9. Random sampling ensures every unit has:
a) An equal chance only
b) A known, non-zero chance of selection
c) No chance of selection
d) A chance based on size only

10. The CLT applies regardless of:
a) Sample size
b) The shape of the original population distribution
c) The sampling method
d) The mean of the population

11. A larger sample size, holding variability constant, results in a sampling distribution that is:
a) More spread out
b) Less spread out (smaller standard error)
c) Unaffected
d) Bimodal

12. Systematic sampling selects units:
a) Purely randomly with no pattern
b) At regular intervals from a list
c) Only from convenient sources
d) By stratifying first always

13. The CLT is most useful because it lets us apply normal-based methods even when:
a) The sample size is tiny
b) The population distribution is unknown/non-normal
c) There is no data
d) The variance is zero

14. A larger sample generally makes the sampling distribution of the mean:
a) Wider
b) Narrower
c) Unchanged
d) Bimodal

15. Simple random sampling gives every unit:
a) An equal, known chance of selection
b) No chance of selection
c) Only a chance if wealthy

d) Selection based on order only

16. The CLT works best/fastest when the underlying population is already:
a) Highly skewed
b) Roughly symmetric
c) Categorical
d) Unknown

Answer Key

1-b 2-b 3-b 4-c 5-b 6-b 7-c 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-a 16-b

Part B — Cumulative, Weeks 1-5

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:

a) Continuous
b) Discrete
c) Uniform
d) Normal

8. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

10. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

11. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

12. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

13. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.
a) Uniform
b) Normal
c) Binomial
d) Poisson

14. Sampling error decreases as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

15. A sampling distribution is the probability distribution of a:

a) Population parameter
b) Statistic computed from samples
c) Single observation
d) Census

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b 13-b 14-b 15-b

Week 6: Estimation & Confidence Intervals

Use this log to track your Statistics study sessions for Week 6. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Point Estimation

Point Estimation

A point estimate is a single value used to estimate a population parameter, e.g. using the sample mean $\bar{x}$ to estimate the population mean μ. An estimator is unbiased if its expected value equals the true parameter ($E[\text{estimator}] = \text{parameter}$) — this is why sample variance divides by $(n-1)$ rather than n.

Additional Practice Example: A machine produces defective items with probability 0.05. In a batch of 20, what distribution models the number of defectives?
Solution: *Binomial(n=20, p=0.05), since each item is an independent trial with two outcomes.*

Day 1 Quiz

1. A confidence interval gives a range of values likely to contain the:
a) Sample statistic
b) Population parameter
c) Standard deviation only
d) p-value

2. A good estimator should be consistent, meaning:
a) It never changes
b) It approaches the true value as sample size grows
c) It equals the mean always
d) It has zero variance

3. A margin of error in a confidence interval is:
a) The full width of the interval
b) Half the width of the interval (the ± part)
c) Always zero
d) Unrelated to sample size

Answer Key

1-b 2-b 3-b

Day 2 — Point Estimation

Point Estimation

A 'good' estimator is typically unbiased, consistent (gets closer to the true value as n grows), and efficient (has the smallest possible variance among unbiased estimators).

Additional Practice Example: Find P(A') if P(A)=0.35.
Solution: *P(A') = 1 - P(A) = 1 - 0.35 = 0.65.*

Day 2 Quiz

1. As confidence level increases, the width of a confidence interval:
a) Decreases
b) Increases
c) Stays the same
d) Becomes zero

2. The critical Z-value for a 99% confidence interval is approximately:
a) 1.65
b) 1.96
c) 2.58
d) 3.00

3. A point estimate provides:
a) A range
b) A single best-guess value
c) A hypothesis
d) A significance level

Answer Key

1-b 2-c 3-b

Day 3 — Confidence Intervals

Confidence Intervals

A confidence interval (CI) gives a range of plausible values for a population parameter, along with a confidence level (e.g. 95%) describing how often such intervals would capture the true parameter across repeated sampling — it is NOT the probability that this specific interval contains the true value.

Additional Practice Example: A dataset has mean 60 and standard deviation 5. What range covers roughly 95% of the data (normal approximation)?
Solution: *Mean ± 2 SD = 60 ± 10 = (50, 70).*

Day 3 Quiz

1. An unbiased estimator has an expected value equal to:
a) The sample statistic
b) The true population parameter
c) Zero
d) The variance

2. A point estimate is:
a) A range of values
b) A single value estimating a parameter
c) Always unbiased
d) A hypothesis test result

3. Doubling the sample size (roughly) changes the margin of error by a factor of about:
a) 2
b) 0.5
c) $1/\sqrt{2} \approx 0.71$
d) 4

Answer Key

1-b 2-b 3-c

Day 4 — Confidence Intervals

Confidence Intervals

For a population mean with known σ: CI = $\bar{x} \pm Z(\alpha/2)\cdot(\sigma/\sqrt{n})$. As the confidence level increases (e.g. 95%→99%), the critical Z-value increases, making the interval wider — there's a direct tradeoff between confidence and precision.

Additional Practice Example: Find the mean of the first 5 even numbers: 2,4,6,8,10.
Solution: *Sum = 30, mean = 30/5 = 6.*

Day 4 Quiz

1. For n=100, $\bar{x}$=50, σ=10, a 95% CI (Z=1.96) is approximately:
a) (45,55)
b) (48.04,51.96)
c) (49,51)
d) (40,60)

2. Increasing sample size n, holding other things constant, makes a confidence interval:
a) Wider
b) Narrower
c) Unchanged
d) Undefined

3. A biased estimator systematically:
a) Equals the parameter
b) Over- or under-estimates the true parameter on average
c) Has zero variance
d) Is always wrong

Answer Key

1-b 2-b 3-b

Day 5 — Confidence Intervals

Confidence Intervals

Worked Example: A sample of n=100 has $\bar{x}$=50, σ=10. A 95% CI uses Z=1.96: 50 ± 1.96(10/√100) = 50 ± 1.96 = (48.04, 51.96).

Additional Practice Example: A dataset is 4, 8, 6, 5, 3, 7. Find the mean.
Solution: *Sum = 4+8+6+5+3+7 = 33. Mean = 33/6 = 5.5.*

Day 5 Quiz

1. A 95% confidence level means:
a) 95% of the data lies in the interval
b) 95% of such intervals (across repeated sampling) contain the true parameter
c) There is a 95% chance this specific interval is correct
d) The sample is 95% accurate

2. A wider confidence interval, all else equal, reflects:
a) More precision
b) Less precision but more confidence
c) No relationship to confidence
d) Always an error

Answer Key

1-b 2-b

Day 6 — Point Estimation (Review)

Point Estimation

A point estimate is a single value used to estimate a population parameter, e.g. using the sample mean $\bar{x}$ to estimate the population mean μ. An estimator is unbiased if its expected value equals the true parameter ($E[\text{estimator}] = \text{parameter}$) — this is why sample variance divides by $(n-1)$ rather than n.

Additional Practice Example: Find the median of the dataset 12, 7, 9, 15, 3.
Solution: *Sort the data: 3, 7, 9, 12, 15. With 5 values, the median is the middle (3rd) value: 9.*

Day 6 Quiz

1. Sample variance divides by (n-1) instead of n to achieve:
a) A larger value always
b) Unbiasedness
c) Faster computation
d) A smaller confidence interval

2. An estimator's efficiency compares its variance to:
a) The population mean
b) Other unbiased estimators' variances
c) The sample size only
d) The confidence level

Answer Key

1-b 2-b

Week 6 Mock Test

Two short tests to close out Week 6: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 6 Only

1. A confidence interval gives a range of values likely to contain the:
a) Sample statistic
b) Population parameter
c) Standard deviation only
d) p-value

2. As confidence level increases, the width of a confidence interval:
a) Decreases
b) Increases
c) Stays the same
d) Becomes zero

3. An unbiased estimator has an expected value equal to:
a) The sample statistic
b) The true population parameter
c) Zero
d) The variance

4. For n=100, $\bar{x}$=50, σ=10, a 95% CI (Z=1.96) is approximately:
a) (45,55)
b) (48.04,51.96)
c) (49,51)
d) (40,60)

5. A 95% confidence level means:
a) 95% of the data lies in the interval
b) 95% of such intervals (across repeated sampling) contain the true parameter
c) There is a 95% chance this specific interval is correct
d) The sample is 95% accurate

6. Sample variance divides by (n-1) instead of n to achieve:
a) A larger value always
b) Unbiasedness
c) Faster computation
d) A smaller confidence interval

7. A good estimator should be consistent, meaning:
a) It never changes
b) It approaches the true value as sample size grows
c) It equals the mean always

d) It has zero variance

8. The critical Z-value for a 99% confidence interval is approximately:
a) 1.65
b) 1.96
c) 2.58
d) 3.00

9. A point estimate is:
a) A range of values
b) A single value estimating a parameter
c) Always unbiased
d) A hypothesis test result

10. Increasing sample size n, holding other things constant, makes a confidence interval:
a) Wider
b) Narrower
c) Unchanged
d) Undefined

11. A wider confidence interval, all else equal, reflects:
a) More precision
b) Less precision but more confidence
c) No relationship to confidence
d) Always an error

12. An estimator's efficiency compares its variance to:
a) The population mean
b) Other unbiased estimators' variances
c) The sample size only
d) The confidence level

13. A margin of error in a confidence interval is:
a) The full width of the interval
b) Half the width of the interval (the ± part)
c) Always zero
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14. A point estimate provides:
a) A range
b) A single best-guess value
c) A hypothesis
d) A significance level

15. Doubling the sample size (roughly) changes the margin of error by a factor of about:
a) 2
b) 0.5
c) $1/\sqrt{2} \approx 0.71$
d) 4

16. A biased estimator systematically:
a) Equals the parameter
b) Over- or under-estimates the true parameter on average
c) Has zero variance
d) Is always wrong

Answer Key

1-b 2-b 3-b 4-b 5-b 6-b 7-b 8-c 9-b 10-b 11-b 12-b 13-b 14-b 15-c 16-b

Part B — Cumulative, Weeks 1-6

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:
a) Continuous

b) Discrete
c) Uniform
d) Normal

8. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

10. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

11. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

12. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

13. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.
a) Uniform
b) Normal
c) Binomial
d) Poisson

14. Sampling error decreases as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

15. A sampling distribution is the probability distribution of a:
a) Population parameter

b) Statistic computed from samples
c) Single observation
d) Census

16. A confidence interval gives a range of values likely to contain the:
a) Sample statistic
b) Population parameter
c) Standard deviation only
d) p-value

17. As confidence level increases, the width of a confidence interval:
a) Decreases
b) Increases
c) Stays the same
d) Becomes zero

18. An unbiased estimator has an expected value equal to:
a) The sample statistic
b) The true population parameter
c) Zero
d) The variance

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b 13-b 14-b 15-b 16-b 17-b 18-b

Week 7: Hypothesis Testing — Z-test, t-test & Chi-square Test

Use this log to track your Statistics study sessions for Week 7. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Hypothesis Testing Framework

Hypothesis Testing Framework

Every hypothesis test starts with a null hypothesis H_0 (typically 'no effect' or 'no difference') and an alternative H_1. You calculate a test statistic from sample data, compare it to a critical value (or compute a p-value), and decide whether to reject H_0.

Additional Practice Example: A coin is tossed 3 times. Find the probability of getting exactly 2 heads (Binomial).
Solution: *$P(X=2) = C(3,2)(0.5)^2(0.5)^1 = 3 \times 0.25 \times 0.5 = 0.375$.*

Day 1 Quiz

1. A t-test is generally used when:
a) Population variance is known and sample is large
b) Population variance is unknown and sample size is small
c) Data is categorical
d) Only for paired data

2. As sample size grows large, the t-distribution converges to the:
a) Binomial distribution
b) Standard normal distribution
c) Poisson distribution
d) Uniform distribution

3. The chi-square goodness-of-fit test compares observed frequencies to:
a) The mean
b) Expected frequencies under a hypothesized distribution
c) The median
d) The mode only

Answer Key

1-b 2-b 3-b

Day 2 — Hypothesis Testing Framework

Hypothesis Testing Framework

Type I error (α): rejecting a true H_0 (a 'false alarm'). Type II error (β): failing to reject a false H_0 (a 'missed detection'). The significance level α (commonly 0.05) is the probability of Type I error you're willing to accept.

Additional Practice Example: A die is rolled. Find P(even number OR number greater than 4).
Solution: *Even = {2,4,6}, >4 = {5,6}. Union = {2,4,5,6}, so P = 4/6 = 2/3.*

Day 2 Quiz

1. The chi-square test is used to test:
a) Difference between two means
b) Association between categorical variables
c) Correlation between continuous variables
d) Trend in a time series

2. The significance level α is the probability of:
a) Type II error
b) Type I error
c) Making a correct decision
d) A sample being biased

3. A larger sample size generally gives a hypothesis test more:
a) Bias
b) Statistical power
c) Type I error only
d) Randomness

Answer Key

1-b 2-b 3-b

Day 3 — Hypothesis Testing Framework

Hypothesis Testing Framework

A two-tailed test (H_1: $\mu \neq$ value) checks for a difference in either direction; a one-tailed test (H_1: $\mu >$ value or $\mu <$ value) checks for a difference in one specific direction only.

Additional Practice Example: If E(X)=10 and Var(X)=9, find $E(X^2)$.
Solution: *$Var(X) = E(X^2) - [E(X)]^2$, so $E(X^2) = Var(X) + [E(X)]^2 = 9 + 100 = 109$.*

Day 3 Quiz

1. A Z-test is appropriate when:
a) Sample size is small and variance unknown
b) Population variance is known and sample size is large
c) Data is nominal
d) Testing correlation

2. A goodness-of-fit test compares:
a) Two sample means
b) Observed vs expected frequencies
c) Two variances
d) Two medians

3. The significance level α is chosen:
a) After collecting data
b) Before conducting the test
c) Only after rejecting H0
d) Randomly each time

Answer Key

1-b 2-b 3-b

Day 4 — Z-test and t-test

Z-test and t-test

Use a Z-test when the population standard deviation σ is known (or the sample size is large, n≥30, by CLT). Use a t-test when σ is unknown and must be estimated from the sample, especially with small samples — the t-distribution has heavier tails than the normal to account for the extra uncertainty from estimating σ.

Additional Practice Example: Find the standard deviation of the dataset 2, 4, 4, 4, 5, 5, 7, 9 (population).
Solution: *Mean = 40/8 = 5. Squared deviations: 9,1,1,1,0,0,4,16, sum=32. Variance = 32/8 = 4. Standard deviation = √4 = 2.*

Day 4 Quiz

1. The null hypothesis represents:
a) The effect being tested for
b) No effect or no difference
c) The alternative claim
d) Something always false

2. Type II error indicates:
a) Accepting H_0 when H_0 is false
b) Rejecting H_0 when H_0 is true
c) Rejecting H_1 when H_1 is true
d) None of the above

3. Failing to reject H0 means:
a) H0 is proven true
b) There isn't enough evidence to reject H0
c) H1 is definitely false
d) The test failed

Answer Key

1-b 2-a 3-b

Day 5 — Z-test and t-test

Z-test and t-test

As sample size grows, the t-distribution converges to the standard normal distribution.

Additional Practice Example: A sample of size 36 has mean 50 and σ=12. Find the standard error.

Solution: *Standard error = σ/√n = 12/√36 = 12/6 = 2.*

Day 5 Quiz

1. Type I error occurs when:

a) Accepting H_0 when H_0 is false
b) Rejecting H_0 when H_0 is true
c) Rejecting H_1 when H_1 is true
d) None of the above

2. A one-tailed hypothesis test is used when:

a) We only care about a difference in one specific direction
b) We always want more statistical power blindly
c) The data is categorical only
d) Sample size is small only

Answer Key

1-b 2-a

Day 6 — Chi-square Test

Chi-square Test

The chi-square (χ^2) test is used for categorical data — most commonly, a test of association/independence between two categorical variables (via a contingency table), or a goodness-of-fit test comparing observed vs. expected frequencies. It is NOT used to compare means of continuous variables — that's what t-tests and ANOVA (F-test) are for.

Additional Practice Example: Two dice are rolled. Find P(sum = 7).
Solution: *There are 6 favorable outcomes out of 36 total: (1,6),(2,5),(3,4),(4,3),(5,2),(6,1). P = 6/36 = 1/6.*

Day 6 Quiz

1. Testing H_0: $\mu=100$ vs H_1: $\mu\neq100$ is a:
a) One-sided upper-tailed test
b) One-sided lower-tailed test
c) Two-tailed test
d) Chi-square test

2. Increasing sample size, holding effect size constant, generally:
a) Decreases statistical power
b) Increases statistical power
c) Has no effect on power
d) Always causes a Type I error

Answer Key

1-c 2-b

Week 7 Mock Test

Two short tests to close out Week 7: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 7 Only

1. A t-test is generally used when:
a) Population variance is known and sample is large
b) Population variance is unknown and sample size is small
c) Data is categorical
d) Only for paired data

2. The chi-square test is used to test:
a) Difference between two means
b) Association between categorical variables
c) Correlation between continuous variables
d) Trend in a time series

3. A Z-test is appropriate when:
a) Sample size is small and variance unknown
b) Population variance is known and sample size is large
c) Data is nominal
d) Testing correlation

4. The null hypothesis represents:
a) The effect being tested for
b) No effect or no difference
c) The alternative claim
d) Something always false

5. Type I error occurs when:
a) Accepting H_0 when H_0 is false
b) Rejecting H_0 when H_0 is true
c) Rejecting H_1 when H_1 is true
d) None of the above

6. Testing H_0: $\mu=100$ vs H_1: $\mu\neq100$ is a:
a) One-sided upper-tailed test
b) One-sided lower-tailed test
c) Two-tailed test
d) Chi-square test

7. As sample size grows large, the t-distribution converges to the:
a) Binomial distribution
b) Standard normal distribution
c) Poisson distribution

d) Uniform distribution

8. The significance level α is the probability of:
a) Type II error
b) Type I error
c) Making a correct decision
d) A sample being biased

9. A goodness-of-fit test compares:
a) Two sample means
b) Observed vs expected frequencies
c) Two variances
d) Two medians

10. Type II error indicates:
a) Accepting H_0 when H_0 is false
b) Rejecting H_0 when H_0 is true
c) Rejecting H_1 when H_1 is true
d) None of the above

11. A one-tailed hypothesis test is used when:
a) We only care about a difference in one specific direction
b) We always want more statistical power blindly
c) The data is categorical only
d) Sample size is small only

12. Increasing sample size, holding effect size constant, generally:
a) Decreases statistical power
b) Increases statistical power
c) Has no effect on power
d) Always causes a Type I error

13. The chi-square goodness-of-fit test compares observed frequencies to:
a) The mean
b) Expected frequencies under a hypothesized distribution
c) The median
d) The mode only

14. A larger sample size generally gives a hypothesis test more:
a) Bias
b) Statistical power
c) Type I error only
d) Randomness

15. The significance level α is chosen:
a) After collecting data
b) Before conducting the test
c) Only after rejecting H0
d) Randomly each time

16. Failing to reject H0 means:
a) H0 is proven true
b) There isn't enough evidence to reject H0
c) H1 is definitely false
d) The test failed

Answer Key

1-b 2-b 3-b 4-b 5-b 6-c 7-b 8-b 9-b 10-a 11-a 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-7

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:
a) Continuous

b) Discrete
c) Uniform
d) Normal

8. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

10. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

11. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

12. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

13. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.
a) Uniform
b) Normal
c) Binomial
d) Poisson

14. Sampling error decreases as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

15. A sampling distribution is the probability distribution of a:
a) Population parameter

b) Statistic computed from samples
c) Single observation
d) Census

16. A confidence interval gives a range of values likely to contain the:
a) Sample statistic
b) Population parameter
c) Standard deviation only
d) p-value

17. As confidence level increases, the width of a confidence interval:
a) Decreases
b) Increases
c) Stays the same
d) Becomes zero

18. An unbiased estimator has an expected value equal to:
a) The sample statistic
b) The true population parameter
c) Zero
d) The variance

19. A t-test is generally used when:
a) Population variance is known and sample is large
b) Population variance is unknown and sample size is small
c) Data is categorical
d) Only for paired data

20. The chi-square test is used to test:
a) Difference between two means
b) Association between categorical variables
c) Correlation between continuous variables
d) Trend in a time series

21. A Z-test is appropriate when:
a) Sample size is small and variance unknown
b) Population variance is known and sample size is large
c) Data is nominal
d) Testing correlation

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b 13-b 14-b 15-b 16-b 17-b 18-b 19-b 20-b 21-b

Week 8: Correlation & Regression

Use this log to track your Statistics study sessions for Week 8. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Correlation

Correlation

The correlation coefficient r (Pearson's) measures the strength and direction of a LINEAR relationship between two continuous variables, ranging from −1 to +1. r = +1 is perfect positive correlation, r = −1 is perfect negative correlation, r = 0 indicates no linear relationship (there could still be a strong non-linear one).

Additional Practice Example: A Poisson process has λ=4 events/hour. Find the probability of exactly 0 events in an hour.
Solution: *$P(X=0) = e^{-4}(4^0)/0! = e^{-4} \approx 0.0183$.*

Day 1 Quiz

1. A correlation coefficient of -1 indicates:
a) No relationship
b) Perfect positive relationship
c) Perfect negative relationship
d) Weak relationship

2. The slope b_1 in $\hat{y}=b_0+b_1x$ represents:
a) The y-intercept
b) Change in ŷ per unit change in x
c) The correlation coefficient
d) The residual

3. A residual in regression is defined as:
a) The predicted value
b) Observed value minus predicted value
c) The slope
d) The correlation coefficient

Answer Key

1-c 2-b 3-b

Day 2 — Correlation

Correlation

Correlation does not imply causation — two variables can be strongly correlated due to a shared underlying cause (a confounding variable) without either causing the other.

Additional Practice Example: Compute a 90% confidence interval for μ if $\bar{x}$=100, σ=15, n=25 (Z=1.645).
Solution: *CI = 100 ± 1.645×(15/√25) = 100 ± 1.645×3 = 100 ± 4.935 = (95.065, 104.935).*

Day 2 Quiz

1. In simple linear regression, R^2 measures:
a) Slope of the line
b) Proportion of variance in Y explained by X
c) The intercept
d) The correlation sign

2. A correlation coefficient of 0 means:
a) No relationship of any kind
b) No LINEAR relationship (non-linear may still exist)
c) Perfect relationship
d) Undefined relationship

3. A correlation of exactly 0 with a clear non-linear pattern shows a limitation of:
a) The mean
b) Pearson's r for non-linear relationships
c) The median
d) The mode

Answer Key

1-b 2-b 3-b

Day 3 — Simple Linear Regression

Simple Linear Regression

Simple linear regression fits a line $\hat{y} = b_0 + b_1 x$ that best predicts y from x, chosen to minimize the sum of squared residuals (differences between observed and predicted y) — the 'least squares' criterion. b_1 is the slope (change in $\hat{y}$ per unit change in x); b_0 is the intercept.

Additional Practice Example: Find the variance of a Binomial(n=50, p=0.2).
Solution: *Variance = $np(1-p) = 50 \times 0.2 \times 0.8 = 8$.*

Day 3 Quiz

1. If two variables move in the same direction, their correlation is:
a) Negative
b) Zero
c) Positive
d) Undefined

2. R^2 ranges between:
a) -1 and 1
b) 0 and 1
c) 0 and 100
d) $-\infty$ and ∞

3. In regression, the intercept b0 represents:
a) The predicted y when x=0
b) The slope
c) The correlation
d) The variance

Answer Key

1-c 2-b 3-a

Day 4 — Simple Linear Regression

Simple Linear Regression

R^2 (the coefficient of determination) is the square of the correlation coefficient in simple linear regression, and represents the proportion of variance in the dependent variable (y) that is explained by the independent variable (x). R^2 ranges from 0 to 1; higher means a better fit.

Additional Practice Example: A correlation study finds r=0.6. What percentage of variance in Y is explained by X?

Solution: *$R^2 = r^2 = 0.36$, so 36% of the variance in Y is explained by X.*

Day 4 Quiz

1. The least squares method minimizes:
a) The sum of residuals
b) The sum of squared residuals
c) The correlation coefficient
d) The slope

2. In time series analysis, the mostly used method for measuring trend is:
a) Semi-average method
b) Moving average method
c) Least squares method
d) Free-hand curve method

3. A scatterplot with points tightly hugging an upward line shows:
a) Weak correlation
b) Strong positive correlation
c) Strong negative correlation
d) No correlation

Answer Key

1-b 2-c 3-b

Day 5 — Simple Linear Regression

Simple Linear Regression

Worked Example: If r = 0.8 between study hours and exam score, $R^2 = 0.64$, meaning 64% of the variation in exam scores is explained by study hours (and 36% by other factors).

Additional Practice Example: Test H_0: $\mu=50$ vs H_1: $\mu\neq50$ with $\bar{x}=53$, $\sigma=6$, $n=36$. Find the Z statistic.

Solution: *$Z = (\bar{x}-\mu)/(\sigma/\sqrt{n}) = (53-50)/(6/6) = 3/1 = 3$.*

Day 5 Quiz

1. If $r=0.8$, then R^2 equals:

a) 0.8
b) 0.64
c) 0.16
d) 1.6

2. A correlation near 0 but a clear curved pattern in a scatterplot suggests:

a) No relationship of any kind
b) A non-linear relationship poorly captured by Pearson's r
c) A calculation error only
d) Perfect correlation

Answer Key

1-b 2-b

Day 6 — Correlation (Review)

Correlation

The correlation coefficient r (Pearson's) measures the strength and direction of a LINEAR relationship between two continuous variables, ranging from −1 to +1. r = +1 is perfect positive correlation, r = −1 is perfect negative correlation, r = 0 indicates no linear relationship (there could still be a strong non-linear one).

Additional Practice Example: A quality control process finds 2 defective items in a sample of 100 ($\hat{p}$=0.02). If the true defect rate is thought to be 5%, is 2% notably lower?

Solution: *This requires a hypothesis test for a proportion; conceptually, since 0.02 is meaningfully below 0.05, a Z-test for proportions would likely reject H_0: p=0.05 in favor of a lower true rate, pending the actual computed p-value.*

Day 6 Quiz

1. Correlation does NOT imply:
a) Association
b) A linear pattern
c) Causation
d) A numeric relationship

2. Multiple regression differs from simple regression by using:
a) Only one predictor
b) Two or more predictor variables
c) No predictors
d) Only categorical outcomes

Answer Key

1-c 2-b

Week 8 Mock Test

Two short tests to close out Week 8: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 8 Only

1. A correlation coefficient of -1 indicates:
a) No relationship
b) Perfect positive relationship
c) Perfect negative relationship
d) Weak relationship

2. In simple linear regression, R^2 measures:
a) Slope of the line
b) Proportion of variance in Y explained by X
c) The intercept
d) The correlation sign

3. If two variables move in the same direction, their correlation is:
a) Negative
b) Zero
c) Positive
d) Undefined

4. The least squares method minimizes:
a) The sum of residuals
b) The sum of squared residuals
c) The correlation coefficient
d) The slope

5. If $r=0.8$, then R^2 equals:
a) 0.8
b) 0.64
c) 0.16
d) 1.6

6. Correlation does NOT imply:
a) Association
b) A linear pattern
c) Causation
d) A numeric relationship

7. The slope b_1 in $\hat{y}=b_0+b_1x$ represents:
a) The y-intercept
b) Change in $\hat{y}$ per unit change in x
c) The correlation coefficient

d) The residual

8. A correlation coefficient of 0 means:
a) No relationship of any kind
b) No LINEAR relationship (non-linear may still exist)
c) Perfect relationship
d) Undefined relationship

9. R^2 ranges between:
a) -1 and 1
b) 0 and 1
c) 0 and 100
d) $-\infty$ and ∞

10. In time series analysis, the mostly used method for measuring trend is:
a) Semi-average method
b) Moving average method
c) Least squares method
d) Free-hand curve method

11. A correlation near 0 but a clear curved pattern in a scatterplot suggests:
a) No relationship of any kind
b) A non-linear relationship poorly captured by Pearson's r
c) A calculation error only
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12. Multiple regression differs from simple regression by using:
a) Only one predictor
b) Two or more predictor variables
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13. A residual in regression is defined as:
a) The predicted value
b) Observed value minus predicted value
c) The slope
d) The correlation coefficient

14. A correlation of exactly 0 with a clear non-linear pattern shows a limitation of:
a) The mean
b) Pearson's r for non-linear relationships
c) The median
d) The mode

15. In regression, the intercept b0 represents:
a) The predicted y when x=0
b) The slope
c) The correlation
d) The variance

16. A scatterplot with points tightly hugging an upward line shows:
a) Weak correlation
b) Strong positive correlation
c) Strong negative correlation
d) No correlation

Answer Key

1-c 2-b 3-c 4-b 5-b 6-c 7-b 8-b 9-b 10-c 11-b 12-b 13-b 14-b 15-a 16-b

Part B — Cumulative, Weeks 1-8

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:
a) Continuous

b) Discrete
c) Uniform
d) Normal

8. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

10. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

11. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

12. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

13. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.
a) Uniform
b) Normal
c) Binomial
d) Poisson

14. Sampling error decreases as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

15. A sampling distribution is the probability distribution of a:
a) Population parameter

b) Statistic computed from samples
c) Single observation
d) Census

16. A confidence interval gives a range of values likely to contain the:
a) Sample statistic
b) Population parameter
c) Standard deviation only
d) p-value

17. As confidence level increases, the width of a confidence interval:
a) Decreases
b) Increases
c) Stays the same
d) Becomes zero

18. An unbiased estimator has an expected value equal to:
a) The sample statistic
b) The true population parameter
c) Zero
d) The variance

19. A t-test is generally used when:
a) Population variance is known and sample is large
b) Population variance is unknown and sample size is small
c) Data is categorical
d) Only for paired data

20. The chi-square test is used to test:
a) Difference between two means
b) Association between categorical variables
c) Correlation between continuous variables
d) Trend in a time series

21. A Z-test is appropriate when:
a) Sample size is small and variance unknown
b) Population variance is known and sample size is large
c) Data is nominal
d) Testing correlation

22. A correlation coefficient of -1 indicates:
a) No relationship
b) Perfect positive relationship
c) Perfect negative relationship
d) Weak relationship

23. In simple linear regression, R^2 measures:
a) Slope of the line
b) Proportion of variance in Y explained by X

c) The intercept
d) The correlation sign

24. If two variables move in the same direction, their correlation is:
a) Negative
b) Zero
c) Positive
d) Undefined

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b 13-b 14-b 15-b 16-b 17-b 18-b 19-b 20-b 21-b 22-c 23-b 24-c

Week 9: Distribution Revision — Consolidated Reference

Use this log to track your Statistics study sessions for Week 9. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Distribution Comparison Table (memorize this)

Distribution Comparison Table (memorize this)

Binomial(n,p): discrete, models number of successes in n trials; Mean = np; Variance = np(1−p); PMF = $C(n,x)p^x(1-p)^{n-x}$.

Extra Practice

2) A fair coin is tossed 10 times. What distribution models the number of heads, and what is the mean? (Answer: Binomial(10, 0.5); mean = 5)

Additional Practice Example: Find P(X<1) for a discrete RV with P(X=0)=0.3, P(X=1)=0.4, P(X=2)=0.3.
Solution: *P(X<1) means strictly less than 1, so only X=0 qualifies: P(X<1) = 0.3.*

Day 1 Quiz

1. The mean and variance of the exponential distribution with rate λ are respectively:
a) λ and $1/\lambda^2$
b) $1/\lambda$ and $1/\lambda^3$
c) $1/\lambda^2$ and λ
d) $1/\lambda$ and $1/\lambda^2$

2. For an exponential distribution with λ=2, the mean is:
a) 2
b) 0.5
c) 4
d) 1

3. The harmonic mean is most appropriate for averaging:
a) Rates such as speed over equal distances
b) Nominal categories
c) Any dataset universally
d) Only integers

Answer Key
1-d 2-b 3-a

Day 2 — Distribution Comparison Table (memorize this)

Distribution Comparison Table (memorize this)

Poisson(λ): discrete, models rare-event counts in an interval; Mean = Variance = λ; PMF = $e^{-}\lambda\lambda^{x}/x!$.

Extra Practice

3) For an exponential distribution with λ=2, find the mean. (Answer: 1/2 = 0.5)

Additional Practice Example: A bag has 5 red and 3 blue balls. Find P(drawing a red ball).
Solution: *Total balls = 8, red = 5. P(red) = 5/8.*

Day 2 Quiz

1. For a hypergeometric distribution, sampling is done:
a) With replacement
b) Without replacement
c) Continuously
d) Using Z-scores

2. The Hypergeometric distribution differs from Binomial mainly because:
a) It has no mean
b) Trials are not independent (no replacement)
c) It's always symmetric
d) It only applies to continuous data

3. The harmonic mean is typically used for averaging:
a) Rates/speeds
b) Nominal categories
c) Binary data only
d) Any random dataset

Answer Key

1-b 2-b 3-a

Day 3 — Distribution Comparison Table (memorize this)

Distribution Comparison Table (memorize this)

Normal(μ,σ^2): continuous, symmetric bell curve; Mean = Median = Mode = μ; used for CLT-based inference; standardized via $Z = (X-\mu)/\sigma$.

Additional Practice Example: Two independent events have P(A)=0.3 and P(B)=0.6. Find P(A or B).
Solution: $P(A \cup B) = P(A)+P(B)-P(A)P(B) = 0.3+0.6-0.18 = 0.72.$

Day 3 Quiz

1. The exponential distribution's defining feature is its:
a) Symmetry
b) Memoryless property
c) Fixed mean of 1
d) Discreteness

2. Which distribution has mean exactly equal to variance?
a) Binomial
b) Normal
c) Poisson
d) Exponential

3. A time series' 'seasonal' component reflects:
a) Random noise
b) Regular, periodic fluctuations (e.g. by month/quarter)
c) A one-time event
d) Long-term growth only

Answer Key

1-b 2-c 3-b

Day 4 — Distribution Comparison Table (memorize this)

Distribution Comparison Table (memorize this)

Exponential(λ): continuous, models waiting time between Poisson events; Mean = 1/λ; Variance = 1/λ²; memoryless property (past waiting time doesn't affect future waiting time).

Additional Practice Example: A sample has values 10, 12, 14, 16, 18. Find the range and the mean.
Solution: *Range = max−min = 18−10 = 8. Mean = (10+12+14+16+18)/5 = 70/5 = 14.*

Day 4 Quiz

1. For Poisson(λ=5), the variance is:
a) 5
b) 25
c) √5
d) 2.5

2. The standard normal distribution is a special case of the normal distribution with:
a) μ=1, σ=0
b) μ=0, σ=1
c) μ=0, σ=0
d) μ=1, σ=1

3. An index number's base period is assigned a value of:
a) 0
b) 1
c) 100
d) 1000

Answer Key
1-a 2-b 3-c

Day 5 — Distribution Comparison Table (memorize this)

Distribution Comparison Table (memorize this)

Hypergeometric: discrete, like Binomial but sampling WITHOUT replacement from a finite population — used when the population is small relative to the sample, so trials are not independent.

Additional Practice Example: If a Poisson variable has mean 3, find P(X=2).
Solution: *$P(X=2) = e^{-3}(3^2)/2! = e^{-3}\times 9/2 \approx 0.0498\times 4.5 \approx 0.224$.*

Day 5 Quiz

1. A fair coin tossed 10 times: the mean number of heads is:
a) 10
b) 5
c) 2.5
d) 1

2. The geometric mean is most appropriate for averaging:
a) Simple sums
b) Rates of growth/ratios over time
c) Categorical labels
d) Binary outcomes only

Answer Key

1-b 2-b

Day 6 — Extra Practice

Extra Practice

1) A call center receives calls at a rate of 5 per minute (Poisson). What is the variance of calls per minute? (Answer: 5, since mean=variance=λ for Poisson)

Additional Practice Example: A normal variable has μ=50, σ=10. Find the Z-score for X=65.
Solution: *$Z = (X-\mu)/\sigma = (65-50)/10 = 1.5$.*

Day 6 Quiz

1. Which distribution is discrete and models rare independent events over an interval?
a) Normal
b) Exponential
c) Poisson
d) Uniform continuous

2. A negative binomial distribution models:
a) Number of successes before a fixed number of failures (or vice versa)
b) Only continuous data
c) Perfectly symmetric data always
d) Only categorical labels

Answer Key

1-c 2-a

Week 9 Mock Test

Two short tests to close out Week 9: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 9 Only

1. The mean and variance of the exponential distribution with rate λ are respectively:
a) λ and $1/\lambda^2$
b) $1/\lambda$ and $1/\lambda^3$
c) $1/\lambda^2$ and λ
d) $1/\lambda$ and $1/\lambda^2$

2. For a hypergeometric distribution, sampling is done:
a) With replacement
b) Without replacement
c) Continuously
d) Using Z-scores

3. The exponential distribution's defining feature is its:
a) Symmetry
b) Memoryless property
c) Fixed mean of 1
d) Discreteness

4. For Poisson($\lambda=5$), the variance is:
a) 5
b) 25
c) $\sqrt{5}$
d) 2.5

5. A fair coin tossed 10 times: the mean number of heads is:
a) 10
b) 5
c) 2.5
d) 1

6. Which distribution is discrete and models rare independent events over an interval?
a) Normal
b) Exponential
c) Poisson
d) Uniform continuous

7. For an exponential distribution with $\lambda=2$, the mean is:
a) 2
b) 0.5
c) 4

d) 1

8. The Hypergeometric distribution differs from Binomial mainly because:
a) It has no mean
b) Trials are not independent (no replacement)
c) It's always symmetric
d) It only applies to continuous data

9. Which distribution has mean exactly equal to variance?
a) Binomial
b) Normal
c) Poisson
d) Exponential

10. The standard normal distribution is a special case of the normal distribution with:
a) $\mu=1, \sigma=0$
b) $\mu=0, \sigma=1$
c) $\mu=0, \sigma=0$
d) $\mu=1, \sigma=1$

11. The geometric mean is most appropriate for averaging:
a) Simple sums
b) Rates of growth/ratios over time
c) Categorical labels
d) Binary outcomes only

12. A negative binomial distribution models:
a) Number of successes before a fixed number of failures (or vice versa)
b) Only continuous data
c) Perfectly symmetric data always
d) Only categorical labels

13. The harmonic mean is most appropriate for averaging:
a) Rates such as speed over equal distances
b) Nominal categories
c) Any dataset universally
d) Only integers

14. The harmonic mean is typically used for averaging:
a) Rates/speeds
b) Nominal categories
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15. A time series' 'seasonal' component reflects:
a) Random noise
b) Regular, periodic fluctuations (e.g. by month/quarter)
c) A one-time event
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16. An index number's base period is assigned a value of:
a) 0
b) 1
c) 100
d) 1000

Answer Key

1-d 2-b 3-b 4-a 5-b 6-c 7-b 8-b 9-c 10-b 11-b 12-a 13-a 14-a 15-b 16-c

Part B — Cumulative, Weeks 1-9

1. Which measure of central tendency is most affected by outliers?
a) Mean
b) Median
c) Mode
d) Range

2. Data such as gender or blood group are examples of:
a) Nominal data
b) Ratio data
c) Interval data
d) Ordinal data

3. Variance is the square of the:
a) Mean
b) Median
c) Standard deviation
d) Range

4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
a) 0.9
b) 0.2
c) 0.1
d) 0.45

5. Bayes' theorem is used to find:
a) Marginal probability
b) Posterior probability given evidence
c) Variance
d) Mean

6. Conditional probability P(A|B) is defined as:
a) P(A∩B)/P(B)
b) P(A)P(B)
c) P(A∪B)
d) P(B)/P(A)

7. A random variable that takes countable values is called:
a) Continuous

b) Discrete
c) Uniform
d) Normal

8. The sum of probabilities of a discrete random variable equals:
a) 0
b) 0.5
c) 1
d) depends on the variable

9. Expected value E(X) of a random variable represents its:
a) Variance
b) Mean
c) Mode
d) Median

10. In a binomial distribution, the mean equals:
a) np
b) np(1-p)
c) p/n
d) n/p

11. The Poisson distribution is typically used for:
a) Continuous data
b) Rare event counts
c) Symmetric data only
d) Ranking data

12. In a normal distribution, mean, median, and mode are:
a) all different
b) all equal
c) mean > median
d) mean < median

13. The Central Limit Theorem states that sample means approach a ___ distribution as sample size increases.
a) Uniform
b) Normal
c) Binomial
d) Poisson

14. Sampling error decreases as:
a) Sample size decreases
b) Sample size increases
c) Population size decreases
d) It is unrelated to sample size

15. A sampling distribution is the probability distribution of a:
a) Population parameter

b) Statistic computed from samples
c) Single observation
d) Census

16. A confidence interval gives a range of values likely to contain the:
a) Sample statistic
b) Population parameter
c) Standard deviation only
d) p-value

17. As confidence level increases, the width of a confidence interval:
a) Decreases
b) Increases
c) Stays the same
d) Becomes zero

18. An unbiased estimator has an expected value equal to:
a) The sample statistic
b) The true population parameter
c) Zero
d) The variance

19. A t-test is generally used when:
a) Population variance is known and sample is large
b) Population variance is unknown and sample size is small
c) Data is categorical
d) Only for paired data

20. The chi-square test is used to test:
a) Difference between two means
b) Association between categorical variables
c) Correlation between continuous variables
d) Trend in a time series

21. A Z-test is appropriate when:
a) Sample size is small and variance unknown
b) Population variance is known and sample size is large
c) Data is nominal
d) Testing correlation

22. A correlation coefficient of -1 indicates:
a) No relationship
b) Perfect positive relationship
c) Perfect negative relationship
d) Weak relationship

23. In simple linear regression, R^2 measures:
a) Slope of the line
b) Proportion of variance in Y explained by X

c) The intercept
d) The correlation sign

24. If two variables move in the same direction, their correlation is:
a) Negative
b) Zero
c) Positive
d) Undefined

25. The mean and variance of the exponential distribution with rate λ are respectively:
a) λ and $1/\lambda^2$
b) $1/\lambda$ and $1/\lambda^3$
c) $1/\lambda^2$ and λ
d) $1/\lambda$ and $1/\lambda^2$

26. For a hypergeometric distribution, sampling is done:
a) With replacement
b) Without replacement
c) Continuously
d) Using Z-scores

27. The exponential distribution's defining feature is its:
a) Symmetry
b) Memoryless property
c) Fixed mean of 1
d) Discreteness

Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b 13-b 14-b 15-b 16-b 17-b 18-b 19-b 20-b 21-b 22-c 23-b 24-c 25-d 26-b 27-b

Week 10: Mixed Practice — All Statistics Topics

Use this log to track your Statistics study sessions for Week 10. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Mixed Problem Set

Mixed Problem Set

This week, practice identifying which statistical tool a word problem needs before solving it — that recognition skill is what the real exam actually tests, more than the arithmetic itself.

Additional Practice Example: Find the coefficient of variation if mean=40 and s.d.=8.
Solution: *CV = (s.d./mean)×100 = (8/40)×100 = 20%.*

Day 1 Quiz

1. In a distribution, Q1=25, Q3=45, median=36. The Bowley coefficient of skewness (Q3+Q1-2Median)/(Q3-Q1) is:
a) -0.2
b) 0.1
c) -0.1
d) 0.2

2. The appropriate test for comparing means across more than two independent groups is:
a) F-test (ANOVA)
b) t-test
c) Z-test
d) Chi-square test

3. A pie chart is most appropriate for displaying:
a) Trends over time
b) Parts of a whole (proportions)
c) Correlations between variables
d) Individual raw data points

Answer Key

1-c 2-a 3-b

Day 2 — Mixed Problem Set

Mixed Problem Set

1) A dataset has quartiles Q1=25, Q3=45, and median=36. Find Bowley's coefficient of skewness: (Q3+Q1−2×Median)/(Q3−Q1). (Answer: (45+25−72)/20 = −0.1)

Additional Practice Example: A regression line is $\hat{y} = 5 + 2x$. Predict y when x=10.
Solution: *$\hat{y} = 5 + 2(10) = 5+20 = 25$.*

Day 2 Quiz

1. If E(X)=5 and Var(X)=4, then $E(X^2)$ equals:
a) 9
b) 20
c) 25
d) 29

2. If X is a random variable with mean μ, $E(X-\mu)^r$ represents the:
a) Variance always
b) rth raw moment
c) rth central moment
d) Standard deviation

3. ANOVA's null hypothesis typically states:
a) All group means are different
b) All group means are equal
c) No groups exist
d) Variance is zero

Answer Key

1-d 2-c 3-b

Day 3 — Mixed Problem Set

Mixed Problem Set

2) If E(X)=5 and Var(X)=4, find E(X²). (Answer: Var=E(X²)−[E(X)]² → E(X²)=4+25=29)

Additional Practice Example: In a class of 40, 25 passed Math and 20 passed Stats, with 15 passing both. Find P(passed Math or Stats).
Solution: *P(M∪S) = P(M)+P(S)−P(M∩S) = 25/40+20/40−15/40 = 30/40 = 0.75.*

Day 3 Quiz

1. A sample of size 25 with s=8 has standard error:
a) 0.32
b) 1.6
c) 3.2
d) 8

2. The coefficient of variation is computed as:
a) (s.d./mean)×100
b) (mean/s.d.)×100
c) (mean×s.d.)/100
d) 100/(mean×s.d.)

3. A bar chart is best suited for comparing:
a) Proportions of a whole
b) Discrete categories' values
c) Continuous trends over time
d) Correlation strength

Answer Key

1-b 2-a 3-b

Day 4 — Mixed Problem Set

Mixed Problem Set

3) A sample of size 25 has s=8. Find the standard error of the mean. (Answer: 8/√25 = 1.6)

Additional Practice Example: A sample variance is 25 with n=16. Find the standard error of the mean.
Solution: *Standard error = s/√n = √25/√16 = 5/4 = 1.25.*

Day 4 Quiz

1. For Binomial(n=20,p=0.3), the variance is:
a) 6
b) 4.2
c) 1.4
d) 14

2. One considers the best-fitted trend line as the one where the sum of squares of errors is:
a) Maximum
b) Minimum
c) Negative
d) Zero always

3. The mode can be found from a histogram by locating the:
a) Widest bar
b) Tallest bar
c) Shortest bar
d) First bar

Answer Key
1-b 2-b 3-b

Day 5 — Mixed Problem Set

Mixed Problem Set

4) In a binomial distribution with n=20, p=0.3, find the mean and variance. (Answer: mean=6, variance=20×0.3×0.7=4.2)

Additional Practice Example: A survey of 50 people finds 30 prefer tea. Find the sample proportion.
Solution: *$\hat{p}$ = 30/50 = 0.6.*

Day 5 Quiz

1. A correlation of r=-0.9 indicates:
a) Weak positive relationship
b) Strong negative linear relationship
c) No relationship
d) Perfect relationship

2. A two-way ANOVA examines the effect of:
a) One factor only
b) Two independent factors (and their interaction) on a outcome
c) No factors
d) Only categorical predictors on categorical outcomes

Answer Key
1-b 2-b

Day 6 — Mixed Problem Set

Mixed Problem Set

5) Two variables have correlation r=−0.9. Describe the relationship in words. (Answer: strong negative linear relationship)

Additional Practice Example: Find the interquartile range (IQR) if Q1=20 and Q3=35.
Solution: *IQR = Q3 - Q1 = 35 - 20 = 15.*

Day 6 Quiz

1. Fisher's index number is the ___ of Laspeyre's and Paasche's index numbers.
a) arithmetic mean
b) geometric mean
c) harmonic mean
d) median

2. An index number expresses:
a) A raw absolute value
b) A relative change compared to a base period
c) Only currency values
d) The mode of a dataset

Answer Key

1-b 2-b

Week 10 Mock Test

Two short tests to close out Week 10: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 10 Only

1. In a distribution, Q1=25, Q3=45, median=36. The Bowley coefficient of skewness (Q3+Q1-2Median)/(Q3-Q1) is:
a) -0.2
b) 0.1
c) -0.1
d) 0.2

2. If E(X)=5 and Var(X)=4, then E(X²) equals:
a) 9
b) 20
c) 25
d) 29

3. A sample of size 25 with s=8 has standard error:
a) 0.32
b) 1.6
c) 3.2
d) 8

4. For Binomial(n=20,p=0.3), the variance is:
a) 6
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c) 1.4
d) 14

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c) harmonic mean
d) median

7. The appropriate test for comparing means across more than two independent groups is:
a) F-test (ANOVA)
b) t-test

c) Z-test
d) Chi-square test

8. If X is a random variable with mean μ, $E(X-\mu)^r$ represents the:
a) Variance always
b) rth raw moment
c) rth central moment
d) Standard deviation

9. The coefficient of variation is computed as:
a) (s.d./mean)×100
b) (mean/s.d.)×100
c) (mean×s.d.)/100
d) 100/(mean×s.d.)

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Part B — Cumulative, Weeks 1-10

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a) Mean
b) Median
c) Mode
d) Range

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4. If P(A)=0.4 and P(B)=0.5, and A, B are independent, P(A∩B) =
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b) 20
c) 25
d) 29

30. A sample of size 25 with s=8 has standard error:
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Answer Key

1-a 2-a 3-c 4-b 5-b 6-a 7-b 8-c 9-b 10-a 11-b 12-b 13-b 14-b 15-b 16-b 17-b 18-b 19-b 20-b 21-b 22-c 23-b 24-c 25-d 26-b 27-b 28-c 29-d 30-b

Statistics — Solved Problem Bank

A set of fully worked problems spanning the whole subject, useful for a final confidence check before moving to the next part. Try each problem yourself before reading the solution.

Problem 1: A dataset is 4, 8, 6, 5, 3, 7. Find the mean.
Solution: *Sum = 4+8+6+5+3+7 = 33. Mean = 33/6 = 5.5.*

Problem 2: Find the median of the dataset 12, 7, 9, 15, 3.
Solution: *Sort the data: 3, 7, 9, 12, 15. With 5 values, the median is the middle (3rd) value: 9.*

Problem 3: A coin is tossed 3 times. Find the probability of getting exactly 2 heads (Binomial).
Solution: *$P(X=2) = C(3,2)(0.5)^2(0.5)^1 = 3 \times 0.25 \times 0.5 = 0.375$.*

Problem 4: A die is rolled. Find P(even number OR number greater than 4).
Solution: *Even = {2,4,6}, >4 = {5,6}. Union = {2,4,5,6}, so P = 4/6 = 2/3.*

Problem 5: If E(X)=10 and Var(X)=9, find $E(X^2)$.
Solution: *$Var(X) = E(X^2) - [E(X)]^2$, so $E(X^2) = Var(X) + [E(X)]^2 = 9 + 100 = 109$.*

Problem 6: Find the standard deviation of the dataset 2, 4, 4, 4, 5, 5, 7, 9 (population).
Solution: *Mean = 40/8 = 5. Squared deviations: 9,1,1,1,0,0,4,16, sum=32. Variance = 32/8 = 4. Standard deviation = $\sqrt{4} = 2$.*

Problem 7: A sample of size 36 has mean 50 and σ=12. Find the standard error.
Solution: *Standard error = $\sigma/\sqrt{n} = 12/\sqrt{36} = 12/6 = 2$.*

Problem 8: Two dice are rolled. Find P(sum = 7).
Solution: *There are 6 favorable outcomes out of 36 total: (1,6),(2,5),(3,4),(4,3),(5,2),(6,1). P = 6/36 = 1/6.*

Problem 9: A Poisson process has λ=4 events/hour. Find the probability of exactly 0 events in an hour.
Solution: *$P(X=0) = e^{-4}(4^0)/0! = e^{-4} \approx 0.0183$.*

Problem 10: Compute a 90% confidence interval for μ if $\bar{x}$=100, σ=15, n=25 (Z=1.645).
Solution: *$CI = 100 \pm 1.645 \times (15/\sqrt{25}) = 100 \pm 1.645 \times 3 = 100 \pm 4.935 = (95.065, 104.935)$.*

Problem 11: Find the variance of a Binomial(n=50, p=0.2).
Solution: *$Variance = np(1-p) = 50 \times 0.2 \times 0.8 = 8$.*

Problem 12: A correlation study finds r=0.6. What percentage of variance in Y is explained by X?
Solution: *$R^2 = r^2 = 0.36$, so 36% of the variance in Y is explained by X.*

Problem 13: Test H_0: μ=50 vs H_1: μ≠50 with $\bar{x}$=53, σ=6, n=36. Find the Z statistic.
Solution: *$Z = (\bar{x} - \mu)/(\sigma/\sqrt{n}) = (53-50)/(6/6) = 3/1 = 3$.*

Problem 14: A quality control process finds 2 defective items in a sample of 100 ($\hat{p}$=0.02). If the true defect rate is thought to be 5%, is 2% notably lower?

Solution: *This requires a hypothesis test for a proportion; conceptually, since 0.02 is meaningfully below 0.05, a Z-test for proportions would likely reject H_0: $p=0.05$ in favor of a lower true rate, pending the actual computed p-value.*

Problem 15: Find P(X<1) for a discrete RV with P(X=0)=0.3, P(X=1)=0.4, P(X=2)=0.3.
Solution: *$P(X<1)$ means strictly less than 1, so only $X=0$ qualifies: $P(X<1) = 0.3$.*

Problem 16: A bag has 5 red and 3 blue balls. Find P(drawing a red ball).
Solution: *Total balls = 8, red = 5. P(red) = 5/8.*

Problem 17: Two independent events have P(A)=0.3 and P(B)=0.6. Find P(A or B).
Solution: *$P(A \cup B) = P(A)+P(B)-P(A)P(B) = 0.3+0.6-0.18 = 0.72$.*

Problem 18: A sample has values 10, 12, 14, 16, 18. Find the range and the mean.
Solution: *Range = max−min = 18−10 = 8. Mean = (10+12+14+16+18)/5 = 70/5 = 14.*

Problem 19: If a Poisson variable has mean 3, find P(X=2).
Solution: *$P(X=2) = e^{-3}(3^2)/2! = e^{-3}\times 9/2 \approx 0.0498\times 4.5 \approx 0.224$.*

Problem 20: A normal variable has μ=50, σ=10. Find the Z-score for X=65.
Solution: *$Z = (X-\mu)/\sigma = (65-50)/10 = 1.5$.*

Problem 21: Find the coefficient of variation if mean=40 and s.d.=8.
Solution: *CV = (s.d./mean)×100 = (8/40)×100 = 20%.*

Problem 22: A regression line is $\hat{y} = 5 + 2x$. Predict y when x=10.
Solution: *$\hat{y} = 5 + 2(10) = 5+20 = 25$.*

Problem 23: In a class of 40, 25 passed Math and 20 passed Stats, with 15 passing both. Find P(passed Math or Stats).
Solution: *$P(M \cup S) = P(M)+P(S)-P(M \cap S) = 25/40+20/40-15/40 = 30/40 = 0.75$.*

Problem 24: A sample variance is 25 with n=16. Find the standard error of the mean.
Solution: *Standard error = $s/\sqrt{n} = \sqrt{25}/\sqrt{16} = 5/4 = 1.25$.*

Problem 25: A survey of 50 people finds 30 prefer tea. Find the sample proportion.
Solution: *$\hat{p} = 30/50 = 0.6$.*

Problem 26: Find the interquartile range (IQR) if Q1=20 and Q3=35.
Solution: *IQR = Q3 - Q1 = 35 - 20 = 15.*

Problem 27: A dataset's z-score for a value is 2. What does this mean?
Solution: *The value lies 2 standard deviations above the mean.*

Problem 28: If a fair die is rolled twice, find P(both rolls show 6).
Solution: *Each roll is independent with $P(6)=1/6$. $P(\text{both})=1/6\times 1/6=1/36$.*

Problem 29: A company's revenue grew from 100 to 121 over 2 years. Find the annual growth rate (geometric mean approach).
Solution: *121/100 = 1.21 over 2 years, so annual factor = $\sqrt{1.21} = 1.1$, meaning 10% annual growth.*

Problem 30: Find the weighted mean of scores 80 (weight 2) and 90 (weight 3).

Solution: *Weighted mean = (80×2+90×3)/(2+3) = (160+270)/5 = 430/5 = 86.*

Problem 31: A machine produces defective items with probability 0.05. In a batch of 20, what distribution models the number of defectives?

Solution: *Binomial(n=20, p=0.05), since each item is an independent trial with two outcomes.*

Problem 32: Find P(A') if P(A)=0.35.

Solution: *P(A') = 1 - P(A) = 1 - 0.35 = 0.65.*

Problem 33: A dataset has mean 60 and standard deviation 5. What range covers roughly 95% of the data (normal approximation)?

Solution: *Mean ± 2 SD = 60 ± 10 = (50, 70).*

Problem 34: Find the mean of the first 5 even numbers: 2,4,6,8,10.

Solution: *Sum = 30, mean = 30/5 = 6.*

Statistics — Glossary of Key Terms

A quick-reference glossary. Read through it once, then use it to test yourself: cover the definitions and try to recall each one from the term alone.

Term	Definition
ANOVA	Analysis of Variance; a statistical test comparing means across three or more groups.
Bias (of an estimator)	The difference between an estimator's expected value and the true population parameter; zero for an unbiased estimator.
Central Limit Theorem	The principle that sample means approach a normal distribution as sample size grows, regardless of the population's original shape.
Confidence Interval	A range of values, computed from sample data, likely to contain a population parameter at a stated confidence level.
Correlation	A measure of the strength and direction of a linear relationship between two variables.
Discrete Random Variable	A variable that can take only countable, distinct values.
Expected Value	The long-run average value of a random variable, weighted by probability.
Hypothesis Testing	A formal procedure for deciding, using sample data, whether to reject a stated null hypothesis.
Mean	The arithmetic average of a set of values.
Median	The middle value of an ordered dataset, robust to outliers.
Null Hypothesis	The default assumption of no effect or no difference, tested against an alternative hypothesis.
p-value	The probability of observing data as extreme as, or more extreme than, what was observed, assuming the null hypothesis is true.
Probability Density Function	A function describing the relative likelihood of a continuous random variable taking a given value.
Regression	A statistical method for modeling the relationship between a dependent variable and one or more independent variables.
Sampling Distribution	The probability distribution of a statistic (like the sample mean) across all possible samples of a given size.
Skewness	A measure of the asymmetry of a probability distribution.
Standard Deviation	The square root of variance; a measure of spread in the original units of the data.
Standard Error	The standard deviation of a sampling distribution, most commonly of the sample mean.
Type I Error	Rejecting a true null hypothesis (a false positive).
Variance	The average squared deviation of data points from the mean.
Binomial Distribution	A discrete distribution modeling the number of successes in a fixed number of independent trials.
Chi-square Test	A statistical test for association between categorical variables or goodness-of-fit to a distribution.
Degrees of Freedom	The number of independent values that can vary in a statistical calculation.
Normal Distribution	A continuous, symmetric, bell-shaped probability distribution defined by its mean and standard deviation.
Outlier	A data point that differs markedly from the rest of the dataset.
Poisson Distribution	A discrete distribution modeling the number of rare, independent events in a fixed interval.
Interquartile Range (IQR)	The difference between the third and first quartiles, measuring the spread of the middle 50% of data.
Proportion	The fraction of a sample or population possessing a certain characteristic.
Weighted Mean	An average where different data points contribute differently based on assigned weights.

Z-score	The number of standard deviations a data point is from the mean.
Quartile	One of three values dividing an ordered dataset into four equal parts.

PART 3

Computer Science & Information Technology

Computer Science & IT carries 25 of the 100 marks, spanning programming fundamentals, data structures, databases, operating systems, networks, and software engineering — a broad but shallow syllabus at entrance-exam level. This part is organized week by week to match the study plan, moving from Python basics through to ML fundamentals.

Because this section is breadth-heavy, prioritize recognizing definitions and core behaviors accurately over deep implementation detail — the exam is conceptual multiple-choice, not a coding test.

This part is organized as 10 weeks of 6 study days each (60 days total), matching a Monday-to-Saturday study rhythm with Sunday reserved for mixed review across all five subjects (see Part 6).

Week 1: Python Basics — Variables, Data Types, Operators, I/O

Use this log to track your Computer Science & Information Technology study sessions for Week 1. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Variables and Data Types

Variables and Data Types

Python is dynamically typed — you don't declare a variable's type; it's inferred from the assigned value, and can change if reassigned. Core built-in types: int (whole numbers), float (decimals), str (text), bool (True/False), and collections like list, tuple, dict, and set.

Additional Practice Example: Trace the output of: for i in range(3): print(i).
Solution: *range(3) generates 0, 1, 2. The loop prints each on its own line: 0, then 1, then 2.*

Day 1 Quiz

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. 5 % 2 in Python evaluates to:
a) 2.5
b) 1
c) 2
d) 0

3. In Python, 'is' compares:
a) Values only
b) Object identity
c) Data types only
d) Nothing valid

Answer Key

1-b 2-b 3-b

Day 2 — Variables and Data Types

Variables and Data Types

Variable names must start with a letter or underscore, can contain letters/digits/underscores, and cannot use Python keywords (like 'if', 'for', 'class'). Names are case-sensitive.

Additional Practice Example: What is the time complexity of nested loops, each running n times?

Solution: *Each outer iteration runs the inner loop n times, and there are n outer iterations, giving $n \times n = O(n^2)$.*

Day 2 Quiz

1. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

2. 2 ** 3 in Python evaluates to:
a) 6
b) 8
c) 5
d) 9

3. A Python list is:
a) Immutable
b) Mutable
c) Always sorted
d) Fixed in size

Answer Key

1-b 2-b 3-b

Day 3 — Operators

Operators

Arithmetic: +, -, *, / (always returns float), // (floor division), % (modulus/remainder), ** (exponent). Comparison: ==, !=, <, >, <=, >=, each returning a bool. Logical: and, or, not. Assignment: =, +=, -=, *=, /=, etc.

Additional Practice Example: Convert the binary number 1011 to decimal.
Solution: *1011 = $1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$ = 8+0+2+1 = 11.*

Day 3 Quiz

1. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

2. Which operator checks equality (not assignment)?
a) =
b) ==
c) !=
d) <>

3. Which symbol starts a comment in Python?
a) //
b) #
c) <!--
d) /*

Answer Key

1-b 2-b 3-b

Day 4 — Operators

Operators

Operator precedence follows standard mathematical convention: parentheses, then exponents, then multiplication/division, then addition/subtraction — remembered by the mnemonic PEMDAS.

Additional Practice Example: A stack has push order A, B, C. What is the pop order?
Solution: *A stack is LIFO, so the last pushed is popped first: the pop order is C, B, A.*

Day 4 Quiz

1. input() in Python always returns a:
a) int
b) float
c) string
d) bool

2. A variable name in Python cannot start with a:
a) Letter
b) Underscore
c) Digit
d) Either letter or underscore

3. The modulus operator % returns the:
a) Quotient
b) Remainder
c) Square
d) Floor value

Answer Key

1-c 2-c 3-b

Day 5 — Input/Output

Input/Output

print() writes to standard output; multiple arguments are separated by a space by default. input() always returns a string, so numeric input must be explicitly converted, e.g. x = int(input()).

Additional Practice Example: Design a simple ER relationship: a Student enrolls in many Courses, and a Course has many Students. What type of relationship is this?

Solution: *This is a many-to-many relationship, typically implemented in a relational database using a junction/bridge table containing foreign keys to both Student and Course.*

Day 5 Quiz

1. The // operator in Python performs:
a) Regular division
b) Floor division
c) Modulus
d) Exponentiation

2. A string in Python is:
a) Mutable
b) Immutable
c) Always numeric
d) A type of loop

Answer Key

1-b 2-b

Day 6 — Input/Output

Input/Output

Worked Example: print(3 + 2 * 2) evaluates 2*2 first (order of operations) giving 4, then 3+4 = 7 — not (3+2)*2 = 10, a very common trap.

Additional Practice Example: Write the SQL to select all employees earning more than 50000.
Solution: *SELECT * FROM Employees WHERE salary > 50000;*

Day 6 Quiz

1. Which is NOT a valid Python data type?
a) int
b) float
c) char
d) str

2. Which built-in function returns the length of a list in Python?
a) size()
b) length()
c) len()
d) count()

Answer Key

1-c 2-c

Week 1 Mock Test

Two short tests to close out Week 1: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 1 Only

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. input() in Python always returns a:
a) int
b) float
c) string
d) bool

5. The // operator in Python performs:
a) Regular division
b) Floor division
c) Modulus
d) Exponentiation

6. Which is NOT a valid Python data type?
a) int
b) float
c) char
d) str

7. 5 % 2 in Python evaluates to:
a) 2.5
b) 1
c) 2

d) 0

8. 2 ** 3 in Python evaluates to:
a) 6
b) 8
c) 5
d) 9

9. Which operator checks equality (not assignment)?
a) =
b) ==
c) !=
d) <>

10. A variable name in Python cannot start with a:
a) Letter
b) Underscore
c) Digit
d) Either letter or underscore

11. A string in Python is:
a) Mutable
b) Immutable
c) Always numeric
d) A type of loop

12. Which built-in function returns the length of a list in Python?
a) size()
b) length()
c) len()
d) count()

13. In Python, 'is' compares:
a) Values only
b) Object identity
c) Data types only
d) Nothing valid

14. A Python list is:
a) Immutable
b) Mutable
c) Always sorted
d) Fixed in size

15. Which symbol starts a comment in Python?
a) //
b) #
c) <!--
d) /*

16. The modulus operator % returns the:
a) Quotient
b) Remainder
c) Square
d) Floor value

Answer Key

1-b 2-b 3-b 4-c 5-b 6-c 7-b 8-b 9-b 10-c 11-b 12-c 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-1

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

Answer Key

1-b 2-b 3-b

Week 2: Functions, Recursion & OOP Concepts

Use this log to track your Computer Science & Information Technology study sessions for Week 2. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Functions

Functions

A function is a reusable, named block of code, defined in Python with 'def'. Functions can take parameters (with optional default values) and return a value using 'return' (if omitted, the function returns None). Parameters are local to the function unless explicitly declared global.

Additional Practice Example: Normalize a table Orders(OrderID, CustomerName, CustomerAddress, ProductID, ProductPrice) — what redundancy exists?

Solution: *CustomerName and CustomerAddress repeat for every order the same customer places, and ProductPrice repeats for every order of the same product — both are redundancies removable by splitting into separate Customer and Product tables linked via foreign keys (3NF).*

Day 1 Quiz

1. Which keyword is used to define a function in Python?

a) func
b) def
c) function
d) define

2. A function with no explicit return statement in Python returns:

a) 0
b) An error
c) None
d) An empty string

3. Tail recursion is notable because it:

a) Can sometimes be optimized into a loop by the compiler
b) Always uses more memory than iteration
c) Cannot terminate
d) Is a syntax error

Answer Key

1-b 2-c 3-a

Day 2 — Recursion

Recursion

A recursive function calls itself to solve a smaller instance of the same problem, and must have a base case — a condition where it stops calling itself — or it will recurse indefinitely and cause a stack overflow. Recursion is elegant for problems with a naturally recursive structure (factorials, tree traversal, Fibonacci) but can be less efficient than iteration due to function-call overhead.

Additional Practice Example: Given processes with burst times P1=5, P2=3, P3=8, find average waiting time using SJF (non-preemptive).
Solution: *SJF order: P2(3), P1(5), P3(8). Waiting times: P2=0, P1=3, P3=8. Average = (0+3+8)/3 = 3.67.*

Day 2 Quiz

1. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

2. Excessive/unterminated recursion commonly causes a:
a) Syntax error
b) Stack overflow
c) Type error
d) Compilation error

3. A class method that runs automatically when an object is created is the:
a) Destructor
b) Constructor
c) Getter
d) Setter

Answer Key
1-b 2-b 3-b

Day 3 — Recursion

Recursion

Worked Example: factorial(n) = n × factorial(n−1), with base case factorial(0) = 1. factorial(4) = 4×3×2×1×1 = 24.

Additional Practice Example: How many bits are needed to represent 100 distinct values?
Solution: *$2^7=128 \geq 100 > 2^6=64$, so 7 bits are required (7 bits can represent up to 128 distinct values).*

Day 3 Quiz

1. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

2. Which pillar of OOP focuses on exposing only essential features?
a) Inheritance
b) Polymorphism
c) Abstraction
d) Encapsulation

3. Which OOP feature lets a subclass provide its own version of a parent method?
a) Overloading
b) Overriding
c) Encapsulation
d) Abstraction

Answer Key

1-d 2-c 3-b

Day 4 — OOP Concepts

OOP Concepts

Object-Oriented Programming organizes code around 'objects' — instances of 'classes' that bundle data (attributes) and behavior (methods). The four pillars: Encapsulation (bundling data and methods, hiding internal details from outside access); Inheritance (a class derives attributes/methods from a parent class, promoting reuse); Polymorphism (the same method name behaves differently depending on the object — via method overriding or overloading); Abstraction (exposing only essential features, hiding implementation complexity).

Additional Practice Example: A binary search tree has values 50, 30, 70, 20, 40. What does in-order traversal produce?

Solution: *In-order visits left-subtree, node, right-subtree recursively, producing sorted order: 20, 30, 40, 50, 70.*

Day 4 Quiz

1. Encapsulation primarily refers to:
a) Deriving a class from another
b) Bundling data and hiding internal details
c) Reusing code via loops
d) Recursion

2. A stack is the data structure mainly used to implement:
a) Iteration
b) Recursive algorithm calls
c) Sorting
d) Hashing

3. A recursive call without progress toward the base case causes:
a) Faster execution
b) Infinite recursion/stack overflow
c) A syntax error
d) Better memory usage

Answer Key

1-b 2-b 3-b

Day 5 — Functions (Review)

Functions

A function is a reusable, named block of code, defined in Python with 'def'. Functions can take parameters (with optional default values) and return a value using 'return' (if omitted, the function returns None). Parameters are local to the function unless explicitly declared global.

Additional Practice Example: Compute the subnet mask for a Class C network split into 4 subnets.

Solution: *4 subnets need 2 extra bits ($2^2=4$), so the mask extends from /24 to /26: 255.255.255.192.*

Day 5 Quiz

1. Inheritance allows a class to:
a) Call itself
b) Acquire properties/methods of another class
c) Hide all its data
d) Avoid using functions

2. A constructor in OOP is used to:
a) Delete an object
b) Initialize a newly created object
c) Compare two objects
d) Sort objects

Answer Key

1-b 2-b

Day 6 — Recursion (Review)

Recursion

A recursive function calls itself to solve a smaller instance of the same problem, and must have a base case — a condition where it stops calling itself — or it will recurse indefinitely and cause a stack overflow. Recursion is elegant for problems with a naturally recursive structure (factorials, tree traversal, Fibonacci) but can be less efficient than iteration due to function-call overhead.

Additional Practice Example: What does the SQL query 'SELECT COUNT(*) FROM Orders WHERE Status="Shipped"' return?

Solution: *It returns the count (a single number) of rows in the Orders table where the Status column equals 'Shipped'.*

Day 6 Quiz

1. factorial(4) using the recursive definition n×factorial(n-1) equals:

a) 12
b) 24
c) 16
d) 20

2. Method overloading means:

a) A subclass redefining a parent method
b) Multiple methods with the same name but different parameters
c) Deleting a method
d) Only one method per class

Answer Key

1-b 2-b

Week 2 Mock Test

Two short tests to close out Week 2: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 2 Only

1. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

2. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

3. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

4. Encapsulation primarily refers to:
a) Deriving a class from another
b) Bundling data and hiding internal details
c) Reusing code via loops
d) Recursion

5. Inheritance allows a class to:
a) Call itself
b) Acquire properties/methods of another class
c) Hide all its data
d) Avoid using functions

6. factorial(4) using the recursive definition n×factorial(n-1) equals:
a) 12
b) 24
c) 16
d) 20

7. A function with no explicit return statement in Python returns:
a) 0
b) An error
c) None

d) An empty string

8. Excessive/unterminated recursion commonly causes a:
a) Syntax error
b) Stack overflow
c) Type error
d) Compilation error

9. Which pillar of OOP focuses on exposing only essential features?
a) Inheritance
b) Polymorphism
c) Abstraction
d) Encapsulation

10. A stack is the data structure mainly used to implement:
a) Iteration
b) Recursive algorithm calls
c) Sorting
d) Hashing

11. A constructor in OOP is used to:
a) Delete an object
b) Initialize a newly created object
c) Compare two objects
d) Sort objects

12. Method overloading means:
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a) Can sometimes be optimized into a loop by the compiler
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c) Cannot terminate
d) Is a syntax error

14. A class method that runs automatically when an object is created is the:
a) Destructor
b) Constructor
c) Getter
d) Setter

15. Which OOP feature lets a subclass provide its own version of a parent method?
a) Overloading
b) Overriding
c) Encapsulation
d) Abstraction

16. A recursive call without progress toward the base case causes:
a) Faster execution
b) Infinite recursion/stack overflow
c) A syntax error
d) Better memory usage

Answer Key

1-b 2-b 3-d 4-b 5-b 6-b 7-c 8-b 9-c 10-b 11-b 12-b 13-a 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-2

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

5. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

6. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d

Week 3: Data Structures — Arrays, Linked Lists, Stack & Queue

Use this log to track your Computer Science & Information Technology study sessions for Week 3. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Arrays and Linked Lists

Arrays and Linked Lists

An array stores elements in contiguous memory, giving O(1) random access via index but O(n) insertion/deletion in the middle (elements must shift). A linked list stores elements as nodes, each holding data and a pointer to the next node — insertion/deletion is O(1) once you have a reference to the location, but access requires O(n) traversal from the head.

Additional Practice Example: A recursive function to compute Fibonacci(n) is defined without memoization. Why is this inefficient for large n?

Solution: *Without memoization, the same sub-problems (e.g. Fibonacci(3)) are recomputed many times across different recursive branches, leading to exponential time complexity $O(2^n)$ instead of the achievable O(n) with memoization or iteration.*

Day 1 Quiz

1. Which data structure follows LIFO order?
a) Queue
b) Stack
c) Array
d) Linked list

2. Depth-first search (DFS) in graphs typically uses a:
a) Queue
b) Stack
c) Hash table
d) Tree only

3. A dequeue (double-ended queue) allows insertion/removal at:
a) Only the front
b) Only the back
c) Both ends
d) Neither end

Answer Key

1-b 2-b 3-c

Day 2 — Arrays and Linked Lists

Arrays and Linked Lists

Trade-off summary: arrays favor fast access; linked lists favor fast insertion/deletion at arbitrary positions, at the cost of extra memory for pointers and no random access.

Additional Practice Example: A hash table has 10 buckets and stores 15 items. What does this imply about collisions?

Solution: *By the pigeonhole principle, since 15 items exceed 10 buckets, at least one bucket must contain more than one item — collisions are guaranteed.*

Day 2 Quiz

1. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

2. A linked list node typically contains:
a) Only data
b) Only a pointer
c) Data and a pointer to the next node
d) An index

3. A stack's 'top' element is the:
a) First element ever pushed
b) Most recently pushed element
c) Always the smallest
d) Always the largest

Answer Key

1-b 2-c 3-b

Day 3 — Stack

Stack

A stack follows LIFO (Last-In-First-Out) order — the last element added is the first removed. Core operations: push (add to top), pop (remove from top), peek/top (view top without removing). Used for function call management (the call stack), undo operations, expression evaluation, and backtracking algorithms.

Additional Practice Example: Identify the OSI layer responsible for translating IP addresses into physical (MAC) addresses via ARP.

Solution: *This function bridges the Network layer (which uses IP addresses) and the Data Link layer (which uses MAC addresses); ARP itself operates as a Network/Data-Link boundary protocol, most commonly associated with the Data Link layer's addressing function.*

Day 3 Quiz

1. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

2. The 'peek' operation on a stack:
a) Removes the top element
b) Views the top element without removing it
c) Adds an element
d) Empties the stack

3. Which structure best models a browser's back button history?
a) Queue
b) Stack
c) Tree
d) Graph

Answer Key

1-b 2-b 3-b

Day 4 — Queue

Queue

A queue follows FIFO (First-In-First-Out) order — the first element added is the first removed. Core operations: enqueue (add to the back), dequeue (remove from the front). Used for task scheduling, breadth-first search (BFS), and buffering (e.g. print queues, request handling).

Additional Practice Example: Trace through: x = 5; x = x + 3; print(x). What is printed?
Solution: *x starts at 5, then x = x+3 reassigns x to 5+3 = 8. The output is 8.*

Day 4 Quiz

1. Inserting an element in the middle of a linked list (given the position) is generally:
a) O(1)
b) O(n)
c) O(log n)
d) O(n^2)

2. Which structure is most suitable for a print job queue in an operating system?
a) Stack
b) Queue
c) Binary tree
d) Hash map

3. An array's fixed size is a limitation compared to a:
a) Stack
b) Dynamic/linked structure
c) Constant
d) Boolean

Answer Key

1-a 2-b 3-b

Day 5 — Arrays and Linked Lists (Review)

Arrays and Linked Lists

An array stores elements in contiguous memory, giving O(1) random access via index but O(n) insertion/deletion in the middle (elements must shift). A linked list stores elements as nodes, each holding data and a pointer to the next node — insertion/deletion is O(1) once you have a reference to the location, but access requires O(n) traversal from the head.

Additional Practice Example: A queue-based BFS explores a graph starting at node A with neighbors B, C. What is visited first after A?

Solution: *BFS visits neighbors in the order they were enqueued; since B and C are both enqueued after A, B (enqueued first, assuming that order) is dequeued and visited next.*

Day 5 Quiz

1. The stack operation that removes the top element is called:

a) Enqueue
b) Dequeue
c) Pop
d) Peek

2. A circular queue solves which limitation of a simple array-based queue?

a) Fixed size only
b) Wasted space after repeated dequeues
c) Sorting speed
d) Random access

Answer Key

1-c 2-b

Day 6 — Arrays and Linked Lists (Review)

Arrays and Linked Lists

Trade-off summary: arrays favor fast access; linked lists favor fast insertion/deletion at arbitrary positions, at the cost of extra memory for pointers and no random access.

Additional Practice Example: Why is quicksort's worst case $O(n^2)$ despite averaging $O(n \log n)$?

Solution: *Quicksort's worst case occurs when the chosen pivot is consistently the smallest or largest element (e.g. an already sorted array with a naive pivot choice), causing the partitions to be maximally unbalanced (size 1 and n-1) at every step, leading to n levels of O(n) work each.*

Day 6 Quiz

1. Breadth-first search (BFS) in graphs typically uses a:

a) Stack
b) Queue
c) Linked list only
d) Array only

2. A doubly linked list allows traversal:

a) Forward only
b) Backward only
c) Both forward and backward
d) Not at all

Answer Key

1-b 2-c

Week 3 Mock Test

Two short tests to close out Week 3: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 3 Only

1. Which data structure follows LIFO order?
a) Queue
b) Stack
c) Array
d) Linked list

2. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

3. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

4. Inserting an element in the middle of a linked list (given the position) is generally:
a) O(1)
b) O(n)
c) O(log n)
d) $O(n^2)$

5. The stack operation that removes the top element is called:
a) Enqueue
b) Dequeue
c) Pop
d) Peek

6. Breadth-first search (BFS) in graphs typically uses a:
a) Stack
b) Queue
c) Linked list only
d) Array only

7. Depth-first search (DFS) in graphs typically uses a:
a) Queue
b) Stack
c) Hash table

d) Tree only

8. A linked list node typically contains:
a) Only data
b) Only a pointer
c) Data and a pointer to the next node
d) An index

9. The 'peek' operation on a stack:
a) Removes the top element
b) Views the top element without removing it
c) Adds an element
d) Empties the stack

10. Which structure is most suitable for a print job queue in an operating system?
a) Stack
b) Queue
c) Binary tree
d) Hash map

11. A circular queue solves which limitation of a simple array-based queue?
a) Fixed size only
b) Wasted space after repeated dequeues
c) Sorting speed
d) Random access

12. A doubly linked list allows traversal:
a) Forward only
b) Backward only
c) Both forward and backward
d) Not at all

13. A dequeue (double-ended queue) allows insertion/removal at:
a) Only the front
b) Only the back
c) Both ends
d) Neither end

14. A stack's 'top' element is the:
a) First element ever pushed
b) Most recently pushed element
c) Always the smallest
d) Always the largest

15. Which structure best models a browser's back button history?
a) Queue
b) Stack
c) Tree
d) Graph

16. An array's fixed size is a limitation compared to a:
a) Stack
b) Dynamic/linked structure
c) Constant
d) Boolean

Answer Key

1-b 2-b 3-b 4-a 5-c 6-b 7-b 8-c 9-b 10-b 11-b 12-c 13-c 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-3

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

5. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

6. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

7. Which data structure follows LIFO order?
a) Queue

b) Stack
c) Array
d) Linked list

8. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

9. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d 7-b 8-b 9-b

Week 4: Trees, Graphs & Sorting Algorithms

Use this log to track your Computer Science & Information Technology study sessions for Week 4. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Trees

Trees

A tree is a hierarchical structure of nodes with a single root and no cycles; each node (except the root) has exactly one parent. A binary tree restricts each node to at most 2 children. A Binary Search Tree (BST) additionally orders nodes so that left-subtree values < node < right-subtree values, enabling O(log n) search on balanced trees.

Additional Practice Example: Compute how many rows a CROSS JOIN of a 4-row table and a 3-row table produces.

Solution: *A CROSS JOIN produces the Cartesian product: every row of the first table paired with every row of the second, giving 4 × 3 = 12 rows.*

Day 1 Quiz

1. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

2. Which sorting algorithm guarantees O(n log n) in the worst case?
a) Quick sort
b) Merge sort
c) Bubble sort
d) Insertion sort

3. A minimum spanning tree connects all vertices of a graph with:
a) Maximum total edge weight
b) Minimum total edge weight, no cycles
c) Random edges
d) Only two vertices

Answer Key

1-b 2-b 3-b

Day 2 — Trees

Trees

Common traversals: in-order (left, node, right — gives sorted order for a BST), pre-order (node, left, right), post-order (left, right, node).

Additional Practice Example: A process needs 3 resource instances but only 2 are currently free. What state does it enter?

Solution: *The process enters the Waiting/Blocked state, since it cannot proceed without acquiring all required resource instances.*

Day 2 Quiz

1. Which sorting algorithm has the best average time complexity?
a) Bubble sort
b) Selection sort
c) Quick sort
d) Insertion sort

2. A graph where edges have direction is called:
a) Undirected
b) Weighted
c) Directed
d) Cyclic

3. A leaf node in a tree has:
a) Two children always
b) No children
c) One child always
d) Infinite children

Answer Key

1-c 2-c 3-b

Day 3 — Graphs

Graphs

A graph is a set of vertices (nodes) connected by edges. Graphs can be directed (edges have direction) or undirected, and weighted (edges carry a value/cost) or unweighted. Represented in memory via an adjacency matrix (2D array, $O(V^2)$ space, O(1) edge lookup) or an adjacency list (list per vertex, more space-efficient for sparse graphs).

Additional Practice Example: What is the output of 'print(type(5/2))' in Python 3?
Solution: *In Python 3, the / operator always performs true (float) division, so 5/2 = 2.5, and type(2.5) is <class 'float'>.*

Day 3 Quiz

1. In-order traversal of a Binary Search Tree gives elements in:
a) Random order
b) Sorted order
c) Reverse order
d) Level order

2. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

3. Which sort has the worst average time complexity among these?
a) Merge sort
b) Quick sort
c) Bubble sort
d) Heap sort

Answer Key

1-b 2-b 3-c

Day 4 — Sorting Algorithms

Sorting Algorithms

Bubble sort and selection sort: simple, $O(n^2)$ average and worst case — rarely used in practice but common in exam questions. Insertion sort: $O(n^2)$ worst case but efficient for nearly-sorted data. Merge sort: O(n log n) guaranteed, stable, but needs O(n) extra space. Quick sort: O(n log n) average, $O(n^2)$ worst case (rare with good pivot choice), in-place, generally the fastest in practice.

Additional Practice Example: A table has 1 million rows and no index on a frequently filtered column. What's the likely consequence?

Solution: *Without an index, queries filtering on that column require a full table scan, checking all 1 million rows — this is significantly slower than an indexed lookup, especially as the table grows.*

Day 4 Quiz

1. Which data structure is mainly used for implementing recursive algorithms?

a) Queue
b) Binary tree
c) Linked list
d) Stack

2. The time complexity of binary search is:

a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

3. A weighted graph's edges carry:

a) No extra information
b) A cost/value
c) Only direction
d) Only color

Answer Key

1-d 2-b 3-b

Day 5 — Sorting Algorithms

Sorting Algorithms

Time complexity notation (Big-O) describes how an algorithm's running time or space grows relative to input size n, focusing on the dominant term as n becomes large.

Additional Practice Example: Convert the decimal number 25 to binary.
Solution: *25 = 16+8+1 = $2^4+2^3+2^0$, so in binary: 11001.*

Day 5 Quiz

1. The worst-case time complexity of quicksort is:
a) O(n log n)
b) $O(n^2)$
c) O(log n)
d) O(n)

2. A complete binary tree is one where:
a) Every node has exactly 2 children
b) All levels are fully filled except possibly the last, filled left to right
c) It has no leaves
d) It is always unbalanced

Answer Key

1-b 2-b

Day 6 — Trees (Review)

Trees

A tree is a hierarchical structure of nodes with a single root and no cycles; each node (except the root) has exactly one parent. A binary tree restricts each node to at most 2 children. A Binary Search Tree (BST) additionally orders nodes so that left-subtree values < node < right-subtree values, enabling O(log n) search on balanced trees.

Additional Practice Example: A linked list has a bug causing infinite traversal. What is the most likely cause?

Solution: *The most likely cause is a cycle in the list — a node's 'next' pointer incorrectly points back to an earlier node instead of eventually reaching a null terminator, so traversal never ends.*

Day 6 Quiz

1. An adjacency matrix representation of a graph takes space proportional to:

a) V
b) E
c) V^2
d) V+E

2. Heap sort has a time complexity of:

a) O(n)
b) O(n log n)
c) $O(n^2)$
d) O(log n)

Answer Key

1-c 2-b

Week 4 Mock Test

Two short tests to close out Week 4: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 4 Only

1. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

2. Which sorting algorithm has the best average time complexity?
a) Bubble sort
b) Selection sort
c) Quick sort
d) Insertion sort

3. In-order traversal of a Binary Search Tree gives elements in:
a) Random order
b) Sorted order
c) Reverse order
d) Level order

4. Which data structure is mainly used for implementing recursive algorithms?
a) Queue
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c) Linked list
d) Stack

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a) O(n log n)
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b) Weighted
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a) Random
b) Sorted
c) Unsorted
d) Circular

10. The time complexity of binary search is:
a) O(n)
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d) O(1)

11. A complete binary tree is one where:
a) Every node has exactly 2 children
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d) Only color

Answer Key

1-b 2-c 3-b 4-d 5-b 6-c 7-b 8-c 9-b 10-b 11-b 12-b 13-b 14-b 15-c 16-b

Part B — Cumulative, Weeks 1-4

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
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b) 7
c) 12
d) 9

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b) Stack
c) Array
d) Linked list

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b) Queue
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d) Graph

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Answer Key

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Week 5: Searching Algorithms & Big-O Notation

Use this log to track your Computer Science & Information Technology study sessions for Week 5. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

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Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Searching Algorithms

Searching Algorithms

Linear search checks each element sequentially: O(n) time, works on any (even unsorted) list. Binary search repeatedly halves the search range by comparing the target to the middle element: O(log n) time, but requires the data to be sorted first.

Additional Practice Example: Convert the decimal number 45 to binary.
Solution: *45 = 32+8+4+1 = $2^5+2^3+2^2+2^0$, giving binary 101101.*

Day 1 Quiz

1. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

2. An algorithm with O(1) complexity means its running time:
a) Grows linearly with n
b) Is constant, independent of n
c) Grows logarithmically
d) Grows exponentially

3. Amortized time complexity refers to:
a) The worst single operation only
b) The average cost per operation over a sequence of operations
c) Best case only
d) Space complexity

Answer Key

1-b 2-b 3-b

Day 2 — Searching Algorithms

Searching Algorithms

Worked Example: Searching for 23 in a sorted list of 1,000,000 elements takes at most ~20 comparisons with binary search ($\log_2 1{,}000{,}000 \approx 20$), versus up to 1,000,000 comparisons with linear search in the worst case.

Additional Practice Example: A function is called with the same input twice. What caching technique avoids redundant computation?

Solution: *Memoization — storing previously computed results keyed by input, and returning the cached result on repeat calls.*

Day 2 Quiz

1. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

2. Binary search's efficiency comes from:
a) Checking every element
b) Repeatedly halving the search space
c) Using a hash table
d) Sorting on the fly

3. Binary search fails if the array is:
a) Sorted
b) Unsorted
c) Small
d) Large

Answer Key

1-b 2-b 3-b

Day 3 — Big-O Notation

Big-O Notation

Big-O describes the upper bound of an algorithm's growth rate as input size n increases, ignoring constants and lower-order terms. Common complexities from fastest to slowest growth: O(1) constant, O(log n) logarithmic, O(n) linear, O(n log n) linearithmic, $O(n^2)$ quadratic, $O(2^n)$ exponential.

Additional Practice Example: What SQL clause sorts query results?
Solution: *ORDER BY, optionally with ASC (default) or DESC.*

Day 3 Quiz

1. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)
c) O(n)
d) $O(n^2)$

2. O(n log n) is the typical complexity of:
a) Bubble sort
b) Linear search
c) Merge sort
d) Binary search alone

3. O(1) time complexity describes an operation that:
a) Scales with input size
b) Takes the same time regardless of input size
c) Is always the slowest
d) Never terminates

Answer Key

1-c 2-c 3-b

Day 4 — Big-O Notation

Big-O Notation

Best practice for measuring an algorithm's efficiency is counting the number of significant/dominant operations as a function of input size, rather than measuring actual clock time (which varies by hardware) or simply counting all lines of code.

Additional Practice Example: A website response takes 200ms on average with a cache, and 2000ms without. What speedup factor does the cache provide?
Solution: *2000/200 = 10x speedup.*

Day 4 Quiz

1. Which of the following complexities grows the fastest as n increases?
a) O(log n)
b) O(n)
c) O(n log n)
d) $O(2^n)$

2. Which searching algorithm works on unsorted data?
a) Binary search only
b) Linear search
c) Both equally require sorted data
d) Neither

3. A linear search checks elements:
a) In sorted order only
b) One by one, in sequence
c) By jumping randomly
d) By halving the range

Answer Key

1-d 2-b 3-b

Day 5 — Searching Algorithms (Review)

Searching Algorithms

Linear search checks each element sequentially: O(n) time, works on any (even unsorted) list.

Binary search repeatedly halves the search range by comparing the target to the middle element: O(log n) time, but requires the data to be sorted first.

Additional Practice Example: Which is faster for searching a sorted 1-million-element array: linear or binary search, and by roughly what factor?

Solution: *Binary search, requiring about log2(1,000,000)≈20 comparisons versus up to 1,000,000 for linear search — roughly a 50,000x improvement in the worst case.*

Day 5 Quiz

1. The best way to measure an algorithm's time complexity is by:

a) Counting algorithm steps loosely
b) Measuring time in seconds
c) Counting significant/dominant operations
d) Reading the source code length

2. Depth-first search on a graph uses which strategy?

a) Explore all neighbors before going deeper
b) Go as deep as possible before backtracking
c) Only visit even-indexed nodes
d) Random walk

Answer Key

1-c 2-b

Day 6 — Searching Algorithms (Review)

Searching Algorithms

Worked Example: Searching for 23 in a sorted list of 1,000,000 elements takes at most ~20 comparisons with binary search ($\log_2 1{,}000{,}000 \approx 20$), versus up to 1,000,000 comparisons with linear search in the worst case.

Additional Practice Example: A relational table violates 1NF because a column stores comma-separated multiple values. How is this fixed?

Solution: *Split the multi-valued column into a separate related table (or separate rows), so each cell holds a single atomic value.*

Day 6 Quiz

1. $\log_2(1{,}000{,}000)$ is approximately:

a) 10
b) 14
c) 20
d) 100

2. A hash function should ideally distribute keys:

a) All into one bucket
b) Uniformly across buckets
c) In sorted order
d) Randomly with no bucket structure

Answer Key

1-c 2-b

Week 5 Mock Test

Two short tests to close out Week 5: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 5 Only

1. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

2. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

3. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)
c) O(n)
d) $O(n^2)$

4. Which of the following complexities grows the fastest as n increases?
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b) O(n)
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Answer Key

1-b 2-b 3-c 4-d 5-c 6-c 7-b 8-b 9-c 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-5

1. Which of the following is a valid Python variable name?
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d) Circular

14. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

15. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)

c) O(n)
d) O(n²)

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d 7-b 8-b 9-b 10-b 11-c 12-b 13-b 14-b 15-c

Week 6: SQL, ER Diagrams, Keys & Normalization

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Day 4				
Day 5				
Day 6				

Day 1 — SQL Fundamentals

SQL Fundamentals

SQL (Structured Query Language) is used to define, query, and manipulate relational databases.

Core statements: SELECT (retrieve data), INSERT (add rows), UPDATE (modify rows), DELETE (remove rows), CREATE/ALTER/DROP (define/modify/remove schema objects).

Additional Practice Example: What does 'idempotent' mean for an HTTP method like GET or PUT?

Solution: *Calling it multiple times has the same effect as calling it once — repeating the request doesn't change the outcome further.*

Day 1 Quiz

1. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

2. 3NF requires elimination of:
a) Partial dependency
b) Transitive dependency
c) Multi-valued dependency
d) All foreign keys

3. Denormalization is sometimes used to:
a) Increase redundancy for improved read performance
b) Always improve write speed only
c) Eliminate all foreign keys
d) Enforce stricter 5NF

Answer Key

1-b 2-b 3-a

Day 2 — SQL Fundamentals

SQL Fundamentals

Logical execution order of a SELECT query (even though written differently) is roughly: FROM → WHERE → GROUP BY → HAVING → SELECT → ORDER BY. WHERE filters individual rows before grouping; HAVING filters groups after aggregation.

Additional Practice Example: A process is scheduled with time quantum 4ms and needs 10ms of CPU time under Round Robin. How many time slices does it need?
Solution: *10/4 = 2.5, rounded up to 3 time slices (the last slice uses only 2ms).*

Day 2 Quiz

1. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

2. A foreign key in a table:
a) Must be unique in that table
b) References a primary key in another table
c) Cannot be null ever
d) Is always the primary key

3. A primary key column cannot contain:
a) Text
b) NULL values
c) Numbers
d) Dates

Answer Key

1-b 2-b 3-b

Day 3 — ER Diagrams and Keys

ER Diagrams and Keys

An Entity-Relationship (ER) diagram models entities (things, e.g. Student), their attributes (e.g. Name, ID), and relationships between entities (e.g. Student 'enrolls in' Course), typically with cardinality (one-to-one, one-to-many, many-to-many).

Additional Practice Example: Why is a linked list generally preferred over an array for a queue used in producer-consumer scenarios with unknown size?

Solution: *A linked list grows dynamically without needing to pre-allocate or resize, unlike a fixed-size array.*

Day 3 Quiz

1. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
c) A relation can have only one super key
d) A relation can have only one candidate key

2. 1NF primarily requires:
a) No transitive dependency
b) Atomic (indivisible) column values
c) No foreign keys
d) A composite key

3. SELECT * FROM Table retrieves:
a) No columns
b) All columns and rows
c) Only the first row
d) Only column names

Answer Key

1-a 2-b 3-b

Day 4 — ER Diagrams and Keys

ER Diagrams and Keys

A primary key uniquely identifies each row in a table and cannot be NULL; a table has exactly one primary key (though it can be composite, spanning multiple columns), but can have multiple candidate keys and multiple foreign keys (references to primary keys in other tables, used to enforce relationships).

Additional Practice Example: What is the output of 5 // 2 in Python?
Solution: *Floor division: 5 // 2 = 2 (rounds down to the nearest integer).*

Day 4 Quiz

1. Which normal form is based on the concept of multi-valued dependency?
a) 2NF
b) 3NF
c) 4NF
d) 5NF

2. Which SQL statement is used to remove rows from a table?
a) DROP
b) DELETE
c) REMOVE
d) TRUNCATE only

3. A 1-to-many relationship example is:
a) Student-Course (many-to-many)
b) One Department has many Employees
c) Two unrelated tables
d) A single table with one row

Answer Key

1-c 2-b 3-b

Day 5 — Normalization

Normalization

Normalization organizes a database schema to reduce redundancy and avoid update/insert/delete anomalies, by progressively splitting tables according to functional dependencies. 1NF: atomic column values (no repeating groups). 2NF: 1NF + no partial dependency (non-key attributes depend on the whole primary key, relevant for composite keys). 3NF: 2NF + no transitive dependency (non-key attributes don't depend on other non-key attributes). BCNF: a stricter version of 3NF. 4NF specifically addresses multi-valued dependencies.

Additional Practice Example: Trace the output of: for i in range(3): print(i).
Solution: *range(3) generates 0, 1, 2. The loop prints each on its own line: 0, then 1, then 2.*

Day 5 Quiz

1. The correct execution order of SQL query clauses is:
a) SELECT, FROM, WHERE
b) SELECT, WHERE, FROM
c) FROM, SELECT, WHERE
d) FROM, WHERE, SELECT

2. A view in SQL is:
a) A physical copy of a table
b) A virtual table based on a query
c) A type of index
d) A stored procedure only

Answer Key

1-d 2-b

Day 6 — SQL Fundamentals (Review)

SQL Fundamentals

SQL (Structured Query Language) is used to define, query, and manipulate relational databases.

Core statements: SELECT (retrieve data), INSERT (add rows), UPDATE (modify rows), DELETE (remove rows), CREATE/ALTER/DROP (define/modify/remove schema objects).

Additional Practice Example: What is the time complexity of nested loops, each running n times?

Solution: *Each outer iteration runs the inner loop n times, and there are n outer iterations, giving $n \times n = O(n^2)$.*

Day 6 Quiz

1. An ER diagram is primarily used to model:

a) Program flow
b) Entities, attributes, and relationships
c) Network topology
d) Sorting algorithms

2. A composite key is:

a) A key made of a single column always
b) A primary key composed of two or more columns together
c) A foreign key only
d) Never allowed in SQL

Answer Key

1-b 2-b

Week 6 Mock Test

Two short tests to close out Week 6: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 6 Only

1. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

2. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

3. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
c) A relation can have only one super key
d) A relation can have only one candidate key

4. Which normal form is based on the concept of multi-valued dependency?
a) 2NF
b) 3NF
c) 4NF
d) 5NF

5. The correct execution order of SQL query clauses is:
a) SELECT, FROM, WHERE
b) SELECT, WHERE, FROM
c) FROM, SELECT, WHERE
d) FROM, WHERE, SELECT

6. An ER diagram is primarily used to model:
a) Program flow
b) Entities, attributes, and relationships
c) Network topology
d) Sorting algorithms

7. 3NF requires elimination of:
a) Partial dependency
b) Transitive dependency
c) Multi-valued dependency

d) All foreign keys

8. A foreign key in a table:
a) Must be unique in that table
b) References a primary key in another table
c) Cannot be null ever
d) Is always the primary key

9. 1NF primarily requires:
a) No transitive dependency
b) Atomic (indivisible) column values
c) No foreign keys
d) A composite key

10. Which SQL statement is used to remove rows from a table?
a) DROP
b) DELETE
c) REMOVE
d) TRUNCATE only

11. A view in SQL is:
a) A physical copy of a table
b) A virtual table based on a query
c) A type of index
d) A stored procedure only

12. A composite key is:
a) A key made of a single column always
b) A primary key composed of two or more columns together
c) A foreign key only
d) Never allowed in SQL

13. Denormalization is sometimes used to:
a) Increase redundancy for improved read performance
b) Always improve write speed only
c) Eliminate all foreign keys
d) Enforce stricter 5NF

14. A primary key column cannot contain:
a) Text
b) NULL values
c) Numbers
d) Dates

15. SELECT * FROM Table retrieves:
a) No columns
b) All columns and rows
c) Only the first row
d) Only column names

16. A 1-to-many relationship example is:
a) Student-Course (many-to-many)
b) One Department has many Employees
c) Two unrelated tables
d) A single table with one row

Answer Key

1-b 2-b 3-a 4-c 5-d 6-b 7-b 8-b 9-b 10-b 11-b 12-b 13-a 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-6

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

5. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

6. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

7. Which data structure follows LIFO order?
a) Queue

b) Stack
c) Array
d) Linked list

8. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

9. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

10. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

11. Which sorting algorithm has the best average time complexity?
a) Bubble sort
b) Selection sort
c) Quick sort
d) Insertion sort

12. In-order traversal of a Binary Search Tree gives elements in:
a) Random order
b) Sorted order
c) Reverse order
d) Level order

13. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

14. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

15. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)

c) O(n)
d) O(n^2)

16. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

17. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

18. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
c) A relation can have only one super key
d) A relation can have only one candidate key

Answer Key

1-b	*2-b*	*3-b*	*4-b*	*5-b*	*6-d*	*7-b*	*8-b*	*9-b*	*10-b*	*11-c*	*12-b*	*13-b*	*14-b*	*15-c*	*16-b*	*17-b*	*18-a*

Week 7: Database Transactions, SQL Joins & Indexing

Use this log to track your Computer Science & Information Technology study sessions for Week 7. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Transactions

Transactions

A database transaction is a sequence of operations treated as a single logical unit, following the ACID properties: Atomicity (all-or-nothing execution), Consistency (moves the database from one valid state to another), Isolation (concurrent transactions don't interfere), Durability (committed changes survive system failure).

Additional Practice Example: Convert the binary number 1011 to decimal.
Solution: *$1011 = 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 = 8+0+2+1 = 11$.*

Day 1 Quiz

1. An INNER JOIN returns:
a) All rows from both tables
b) Only matching rows from both tables
c) All rows from the left table only
d) No rows

2. The main cost of adding more indexes to a table is:
a) Slower reads
b) Slower writes (INSERT/UPDATE/DELETE)
c) No cost at all
d) Loss of data

3. Write-ahead logging is used in databases primarily to support:
a) Faster indexing
b) Durability and crash recovery
c) Faster joins
d) Data visualization

Answer Key

1-b 2-b 3-b

Day 2 — Transactions

Transactions

Transaction states: Active (executing) → Partially Committed (finished executing, not yet made permanent) → Committed (successfully finished and saved) OR Failed → Aborted (rolled back).

Additional Practice Example: A stack has push order A, B, C. What is the pop order?
Solution: *A stack is LIFO, so the last pushed is popped first: the pop order is C, B, A.*

Day 2 Quiz

1. Indexing in a database primarily improves:
a) Data security
b) Query performance
c) Data redundancy
d) Normalization

2. Isolation in ACID ensures:
a) Transactions are durable
b) Concurrent transactions don't interfere with each other
c) Data is always indexed
d) Queries run faster

3. A transaction's 'Isolation' property ensures:
a) Data loss on failure
b) Concurrent transactions don't interfere
c) Faster queries
d) Automatic indexing

Answer Key

1-b 2-b 3-b

Day 3 — SQL Joins

SQL Joins

INNER JOIN returns only rows with matching values in both tables. LEFT (OUTER) JOIN returns all rows from the left table plus matched rows from the right (unmatched right-side columns become NULL). RIGHT JOIN is the mirror of LEFT JOIN. FULL OUTER JOIN returns all rows from both tables, matched where possible.

Additional Practice Example: Design a simple ER relationship: a Student enrolls in many Courses, and a Course has many Students. What type of relationship is this?

Solution: *This is a many-to-many relationship, typically implemented in a relational database using a junction/bridge table containing foreign keys to both Student and Course.*

Day 3 Quiz

1. A transaction that has completed all operations but not yet committed is in the:
a) Active state
b) Partially committed state
c) Committed state
d) Failed state

2. A FULL OUTER JOIN returns:
a) Only matched rows
b) All rows from both tables, matched where possible
c) Only left table rows
d) Only right table rows

3. A RIGHT JOIN returns all rows from:
a) The left table only
b) The right table (plus matches from left)
c) Neither table
d) Only matched rows

Answer Key

1-b 2-b 3-b

Day 4 — Indexing

Indexing

An index is a data structure (commonly a B-tree) that speeds up data retrieval on a table, at the cost of extra storage and slower writes (since the index must also be updated on INSERT/UPDATE/DELETE). Indexes dramatically improve query performance for WHERE clauses, JOINs, and ORDER BY on indexed columns, but should be used selectively — over-indexing hurts write performance.

Additional Practice Example: Write the SQL to select all employees earning more than 50000.
Solution: *SELECT * FROM Employees WHERE salary > 50000;*

Day 4 Quiz

1. The 'A' in ACID stands for:
a) Availability
b) Atomicity
c) Accuracy
d) Association

2. After a transaction fails partway through, the database performs a:
a) Commit
b) Rollback (abort)
c) Index rebuild
d) Join

3. Adding an index generally makes SELECT queries on that column:
a) Slower
b) Faster
c) Unaffected
d) Impossible

Answer Key

1-b 2-b 3-b

Day 5 — Transactions (Review)

Transactions

A database transaction is a sequence of operations treated as a single logical unit, following the ACID properties: Atomicity (all-or-nothing execution), Consistency (moves the database from one valid state to another), Isolation (concurrent transactions don't interfere), Durability (committed changes survive system failure).

Additional Practice Example: Normalize a table Orders(OrderID, CustomerName, CustomerAddress, ProductID, ProductPrice) — what redundancy exists?

Solution: *CustomerName and CustomerAddress repeat for every order the same customer places, and ProductPrice repeats for every order of the same product — both are redundancies removable by splitting into separate Customer and Product tables linked via foreign keys (3NF).*

Day 5 Quiz

1. A LEFT JOIN returns:
a) Only matching rows
b) All rows from the left table plus matches from the right
c) All rows from the right table only
d) No unmatched rows ever

2. A savepoint within a transaction allows:
a) Committing the whole transaction early
b) Partial rollback to a specific point without aborting the entire transaction
c) Deleting the transaction log
d) Skipping isolation

Answer Key

1-b 2-b

Day 6 — Transactions (Review)

Transactions

Transaction states: Active (executing) → Partially Committed (finished executing, not yet made permanent) → Committed (successfully finished and saved) OR Failed → Aborted (rolled back).

Additional Practice Example: Given processes with burst times P1=5, P2=3, P3=8, find average waiting time using SJF (non-preemptive).
Solution: *SJF order: P2(3), P1(5), P3(8). Waiting times: P2=0, P1=3, P3=8. Average = (0+3+8)/3 = 3.67.*

Day 6 Quiz

1. Durability in ACID means:
a) Transactions run in isolation
b) Committed data survives system failure
c) Data types remain consistent
d) Queries execute quickly

2. A self-join in SQL joins:
a) Two different databases
b) A table to itself
c) Only views
d) Only indexed tables

Answer Key

1-b 2-b

Week 7 Mock Test

Two short tests to close out Week 7: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 7 Only

1. An INNER JOIN returns:
a) All rows from both tables
b) Only matching rows from both tables
c) All rows from the left table only
d) No rows

2. Indexing in a database primarily improves:
a) Data security
b) Query performance
c) Data redundancy
d) Normalization

3. A transaction that has completed all operations but not yet committed is in the:
a) Active state
b) Partially committed state
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14. A transaction's 'Isolation' property ensures:
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15. A RIGHT JOIN returns all rows from:
a) The left table only
b) The right table (plus matches from left)
c) Neither table
d) Only matched rows

16. Adding an index generally makes SELECT queries on that column:
a) Slower
b) Faster
c) Unaffected
d) Impossible

Answer Key

1-b 2-b 3-b 4-b 5-b 6-b 7-b 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-7

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

5. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

6. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

7. Which data structure follows LIFO order?
a) Queue

b) Stack
c) Array
d) Linked list

8. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

9. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

10. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

11. Which sorting algorithm has the best average time complexity?
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b) Sorted
c) Unsorted
d) Circular

14. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

15. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)

c) O(n)
d) O(n²)

16. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

17. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

18. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
c) A relation can have only one super key
d) A relation can have only one candidate key

19. An INNER JOIN returns:
a) All rows from both tables
b) Only matching rows from both tables
c) All rows from the left table only
d) No rows

20. Indexing in a database primarily improves:
a) Data security
b) Query performance
c) Data redundancy
d) Normalization

21. A transaction that has completed all operations but not yet committed is in the:
a) Active state
b) Partially committed state
c) Committed state
d) Failed state

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d 7-b 8-b 9-b 10-b 11-c 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b

Week 8: Operating Systems — Processes, Threads, Scheduling & Deadlocks

Use this log to track your Computer Science & Information Technology study sessions for Week 8. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Processes and Threads

Processes and Threads

A process is a program in execution, with its own memory space. A thread is a lighter-weight unit of execution within a process; multiple threads within the same process share memory but run independently, enabling concurrency with lower overhead than multiple full processes.

Additional Practice Example: How many bits are needed to represent 100 distinct values?
Solution: *$2^7=128 \geq 100 > 2^6=64$, so 7 bits are required (7 bits can represent up to 128 distinct values).*

Day 1 Quiz

1. Which OS scheduling algorithm can cause starvation?
a) Round Robin
b) Shortest Job First
c) FCFS
d) None of the above

2. FCFS scheduling is:
a) Preemptive
b) Non-preemptive
c) Only used for I/O
d) The fastest algorithm always

3. Multi-level feedback queue scheduling allows a process to:
a) Stay in one queue forever
b) Move between different priority queues based on behavior
c) Skip scheduling entirely
d) Only run once

Answer Key

1-b 2-b 3-b

Day 2 — Processes and Threads

Processes and Threads

Process states typically include: New, Ready (waiting for CPU), Running (executing), Waiting/Blocked (waiting on I/O or an event), and Terminated.

Additional Practice Example: A binary search tree has values 50, 30, 70, 20, 40. What does in-order traversal produce?

Solution: *In-order visits left-subtree, node, right-subtree recursively, producing sorted order: 20, 30, 40, 50, 70.*

Day 2 Quiz

1. A deadlock occurs when:
a) Processes wait indefinitely for resources held by each other
b) A process completes normally
c) CPU is idle
d) Memory is full

2. Breaking which single Coffman condition is often used to prevent deadlock?
a) Any one of the four is sufficient
b) All four simultaneously required
c) None can be broken
d) Only mutual exclusion works

3. A zombie process lingers because:
a) It's still running
b) Its parent hasn't read its exit status yet
c) It has too much memory
d) It was never started

Answer Key

1-a 2-a 3-b

Day 3 — CPU Scheduling

CPU Scheduling

FCFS (First-Come-First-Served): simple, non-preemptive, can cause long wait times (convoy effect). SJF (Shortest Job First): minimizes average waiting time optimally but can starve long processes. Round Robin: each process gets a fixed time quantum in rotation — it is the preemptive version of FCFS, fair and good for time-sharing systems, but performance depends heavily on quantum size.

Additional Practice Example: Compute the subnet mask for a Class C network split into 4 subnets.
Solution: *4 subnets need 2 extra bits ($2^2=4$), so the mask extends from /24 to /26: 255.255.255.192.*

Day 3 Quiz

1. Which of these is NOT one of the four necessary conditions for deadlock?
a) Mutual exclusion
b) Hold and wait
c) Preemption
d) Circular wait

2. SJF scheduling primarily aims to minimize:
a) Context switches
b) Average waiting time
c) Memory usage
d) Number of processes

3. FCFS scheduling processes jobs in the order:
a) Shortest job first
b) They arrive
c) Random order
d) Priority order

Answer Key

1-c 2-b 3-b

Day 4 — Deadlocks

Deadlocks

A deadlock occurs when a set of processes are each waiting for a resource held by another process in the set, so none can proceed. Four necessary conditions (Coffman conditions) must ALL hold simultaneously for deadlock to occur: Mutual Exclusion (resources can't be shared), Hold and Wait (a process holds a resource while waiting for another), No Preemption (resources can't be forcibly taken away), and Circular Wait (a cycle of processes each waiting on the next).

Additional Practice Example: What does the SQL query 'SELECT COUNT(*) FROM Orders WHERE Status="Shipped"' return?

Solution: *It returns the count (a single number) of rows in the Orders table where the Status column equals 'Shipped'.*

Day 4 Quiz

1. Round-robin scheduling is the preemptive version of:
a) Shortest job first
b) Shortest remaining time first
c) FCFS
d) Longest time first

2. Round Robin scheduling's performance depends heavily on:
a) The number of processes only
b) The size of the time quantum
c) The CPU clock speed only
d) The disk speed

3. Thrashing in an OS refers to:
a) Fast execution
b) Excessive paging activity that degrades performance
c) A type of virus
d) A scheduling algorithm

Answer Key

1-c 2-b 3-b

Day 5 — Deadlocks

Deadlocks

Breaking any one of these four conditions prevents deadlock — this is the basis of deadlock prevention strategies.

Additional Practice Example: A recursive function to compute Fibonacci(n) is defined without memoization. Why is this inefficient for large n?

Solution: *Without memoization, the same sub-problems (e.g. Fibonacci(3)) are recomputed many times across different recursive branches, leading to exponential time complexity $O(2^n)$ instead of the achievable O(n) with memoization or iteration.*

Day 5 Quiz

1. A thread differs from a process mainly because it:

a) Has its own separate memory space
b) Shares memory with other threads in the same process
c) Cannot run concurrently
d) Is always slower to create

2. Virtual memory allows a process to use more memory than physically available by:

a) Deleting unused programs
b) Using disk space to extend apparent RAM
c) Compressing all data
d) Ignoring memory limits

Answer Key

1-b 2-b

Day 6 — Processes and Threads (Review)

Processes and Threads

A process is a program in execution, with its own memory space. A thread is a lighter-weight unit of execution within a process; multiple threads within the same process share memory but run independently, enabling concurrency with lower overhead than multiple full processes.

Additional Practice Example: A hash table has 10 buckets and stores 15 items. What does this imply about collisions?
Solution: *By the pigeonhole principle, since 15 items exceed 10 buckets, at least one bucket must contain more than one item — collisions are guaranteed.*

Day 6 Quiz

1. The process state where a process is waiting for I/O is called:
a) Ready
b) Running
c) Waiting/Blocked
d) Terminated

2. A context switch is the process of:
a) Deleting a process
b) Saving/restoring process state to switch the CPU between processes
c) Formatting memory
d) Compiling code

Answer Key

1-c 2-b

Week 8 Mock Test

Two short tests to close out Week 8: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 8 Only

1. Which OS scheduling algorithm can cause starvation?
a) Round Robin
b) Shortest Job First
c) FCFS
d) None of the above

2. A deadlock occurs when:
a) Processes wait indefinitely for resources held by each other
b) A process completes normally
c) CPU is idle
d) Memory is full

3. Which of these is NOT one of the four necessary conditions for deadlock?
a) Mutual exclusion
b) Hold and wait
c) Preemption
d) Circular wait

4. Round-robin scheduling is the preemptive version of:
a) Shortest job first
b) Shortest remaining time first
c) FCFS
d) Longest time first

5. A thread differs from a process mainly because it:
a) Has its own separate memory space
b) Shares memory with other threads in the same process
c) Cannot run concurrently
d) Is always slower to create

6. The process state where a process is waiting for I/O is called:
a) Ready
b) Running
c) Waiting/Blocked
d) Terminated

7. FCFS scheduling is:
a) Preemptive
b) Non-preemptive
c) Only used for I/O

d) The fastest algorithm always

8. Breaking which single Coffman condition is often used to prevent deadlock?
a) Any one of the four is sufficient
b) All four simultaneously required
c) None can be broken
d) Only mutual exclusion works

9. SJF scheduling primarily aims to minimize:
a) Context switches
b) Average waiting time
c) Memory usage
d) Number of processes

10. Round Robin scheduling's performance depends heavily on:
a) The number of processes only
b) The size of the time quantum
c) The CPU clock speed only
d) The disk speed

11. Virtual memory allows a process to use more memory than physically available by:
a) Deleting unused programs
b) Using disk space to extend apparent RAM
c) Compressing all data
d) Ignoring memory limits

12. A context switch is the process of:
a) Deleting a process
b) Saving/restoring process state to switch the CPU between processes
c) Formatting memory
d) Compiling code

13. Multi-level feedback queue scheduling allows a process to:
a) Stay in one queue forever
b) Move between different priority queues based on behavior
c) Skip scheduling entirely
d) Only run once

14. A zombie process lingers because:
a) It's still running
b) Its parent hasn't read its exit status yet
c) It has too much memory
d) It was never started

15. FCFS scheduling processes jobs in the order:
a) Shortest job first
b) They arrive
c) Random order
d) Priority order

16. Thrashing in an OS refers to:
a) Fast execution
b) Excessive paging activity that degrades performance
c) A type of virus
d) A scheduling algorithm

Answer Key

1-b 2-a 3-c 4-c 5-b 6-c 7-b 8-a 9-b 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-8

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

5. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

6. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

7. Which data structure follows LIFO order?
a) Queue

b) Stack
c) Array
d) Linked list

8. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

9. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

10. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

11. Which sorting algorithm has the best average time complexity?
a) Bubble sort
b) Selection sort
c) Quick sort
d) Insertion sort

12. In-order traversal of a Binary Search Tree gives elements in:
a) Random order
b) Sorted order
c) Reverse order
d) Level order

13. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

14. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

15. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)

c) O(n)
d) $O(n^2)$

16. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

17. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

18. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
c) A relation can have only one super key
d) A relation can have only one candidate key

19. An INNER JOIN returns:
a) All rows from both tables
b) Only matching rows from both tables
c) All rows from the left table only
d) No rows

20. Indexing in a database primarily improves:
a) Data security
b) Query performance
c) Data redundancy
d) Normalization

21. A transaction that has completed all operations but not yet committed is in the:
a) Active state
b) Partially committed state
c) Committed state
d) Failed state

22. Which OS scheduling algorithm can cause starvation?
a) Round Robin
b) Shortest Job First
c) FCFS
d) None of the above

23. A deadlock occurs when:
a) Processes wait indefinitely for resources held by each other
b) A process completes normally
c) CPU is idle

d) Memory is full

24. Which of these is NOT one of the four necessary conditions for deadlock?

a) Mutual exclusion
b) Hold and wait
c) Preemption
d) Circular wait

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d 7-b 8-b 9-b 10-b 11-c 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b 22-b 23-a 24-c

Week 9: Computer Networks — OSI Model, TCP/IP, HTTP, DNS, IP Addressing

Use this log to track your Computer Science & Information Technology study sessions for Week 9. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — The OSI Model

The OSI Model

The OSI model has 7 layers (bottom to top): Physical (raw bits over a medium), Data Link (framing, MAC addressing, error detection on a local link), Network (routing, logical addressing — IP), Transport (end-to-end delivery, reliability — TCP/UDP), Session (managing sessions/connections), Presentation (data format, encryption/compression), Application (user-facing protocols like HTTP, FTP, DNS).

Additional Practice Example: Identify the OSI layer responsible for translating IP addresses into physical (MAC) addresses via ARP.

Solution: *This function bridges the Network layer (which uses IP addresses) and the Data Link layer (which uses MAC addresses); ARP itself operates as a Network/Data-Link boundary protocol, most commonly associated with the Data Link layer's addressing function.*

Day 1 Quiz

1. In the OSI model, which layer is responsible for routing?
a) Physical
b) Data Link
c) Network
d) Transport

2. UDP is preferred over TCP when:
a) Reliability matters most
b) Speed matters more than guaranteed delivery
c) Data must arrive in perfect order always
d) Encryption is required

3. Bandwidth refers to:
a) The physical length of a cable
b) The maximum data transfer rate of a connection
c) The number of connected devices
d) The IP address range

Answer Key

1-c 2-b 3-b

Day 2 — The OSI Model

The OSI Model

Mnemonic (bottom to top): 'Please Do Not Throw Sausage Pizza Away' (Physical, Data Link, Network, Transport, Session, Presentation, Application).

Additional Practice Example: Trace through: x = 5; x = x + 3; print(x). What is printed?
Solution: *x starts at 5, then x = x+3 reassigns x to 5+3 = 8. The output is 8.*

Day 2 Quiz

1. HTTP operates primarily at which OSI layer?
a) Transport
b) Application
c) Network
d) Session

2. DNS stands for:
a) Domain Name System
b) Document Name System
c) Discrete Name System
d) Disk Name System

3. A MAC address operates primarily at which layer?
a) Application
b) Data Link
c) Transport
d) Session

Answer Key

1-b 2-a 3-b

Day 3 — TCP/IP and Common Protocols

TCP/IP and Common Protocols

TCP (Transmission Control Protocol) is connection-oriented and guarantees reliable, ordered delivery (with acknowledgments and retransmission) — used where correctness matters (web pages, email, file transfer). UDP (User Datagram Protocol) is connectionless and faster but offers no delivery guarantee — used where speed matters more than perfect reliability (video streaming, gaming, DNS lookups).

Additional Practice Example: A queue-based BFS explores a graph starting at node A with neighbors B, C. What is visited first after A?

Solution: *BFS visits neighbors in the order they were enqueued; since B and C are both enqueued after A, B (enqueued first, assuming that order) is dequeued and visited next.*

Day 3 Quiz

1. DNS is primarily used to:
a) Encrypt data
b) Translate domain names to IP addresses
c) Assign MAC addresses
d) Route packets physically

2. HTTPS differs from HTTP mainly by adding:
a) Faster speed
b) Encryption via TLS/SSL
c) A different port only
d) Compression only

3. Port 443 is commonly associated with:
a) HTTP
b) HTTPS
c) FTP
d) DNS

Answer Key

1-b 2-b 3-b

Day 4 — TCP/IP and Common Protocols

TCP/IP and Common Protocols

HTTP (HyperText Transfer Protocol) is an Application-layer protocol for transferring web content; HTTPS adds TLS/SSL encryption for security. DNS (Domain Name System) translates human-readable domain names (e.g. example.com) into IP addresses that computers use to route traffic.

Additional Practice Example: Why is quicksort's worst case $O(n^2)$ despite averaging $O(n \log n)$?

Solution: *Quicksort's worst case occurs when the chosen pivot is consistently the smallest or largest element (e.g. an already sorted array with a naive pivot choice), causing the partitions to be maximally unbalanced (size 1 and n-1) at every step, leading to n levels of O(n) work each.*

Day 4 Quiz

1. In TCP/IP, which protocol guarantees reliable delivery?
a) UDP
b) IP
c) TCP
d) ICMP

2. Which OSI layer is responsible for end-to-end reliable delivery?
a) Network
b) Transport
c) Session
d) Application

3. A router's main job is to:
a) Store files
b) Forward packets between networks
c) Render web pages
d) Compile code

Answer Key

1-c 2-b 3-b

Day 5 — IP Addressing

IP Addressing

An IPv4 address has 4 octets (32 bits total), e.g. 192.168.1.1. Address classes: Class A (large networks, default mask 255.0.0.0), Class B (default mask 255.255.0.0), Class C (small networks, default mask 255.255.255.0). Subnetting divides a network into smaller sub-networks by borrowing bits from the host portion of the address, extending the subnet mask (e.g. 255.255.255.192 for finer-grained Class C subnetting).

Additional Practice Example: Compute how many rows a CROSS JOIN of a 4-row table and a 3-row table produces.

Solution: *A CROSS JOIN produces the Cartesian product: every row of the first table paired with every row of the second, giving 4 × 3 = 12 rows.*

Day 5 Quiz

1. A Class C IP address' default subnet mask is:
a) 255.0.0.0
b) 255.255.0.0
c) 255.255.255.0
d) 255.255.255.255

2. NAT (Network Address Translation) is primarily used to:
a) Encrypt all traffic
b) Allow multiple devices to share a single public IP address
c) Assign MAC addresses
d) Speed up DNS lookups

Answer Key

1-c 2-b

Day 6 — The OSI Model (Review)

The OSI Model

The OSI model has 7 layers (bottom to top): Physical (raw bits over a medium), Data Link (framing, MAC addressing, error detection on a local link), Network (routing, logical addressing — IP), Transport (end-to-end delivery, reliability — TCP/UDP), Session (managing sessions/connections), Presentation (data format, encryption/compression), Application (user-facing protocols like HTTP, FTP, DNS).

Additional Practice Example: A process needs 3 resource instances but only 2 are currently free. What state does it enter?

Solution: *The process enters the Waiting/Blocked state, since it cannot proceed without acquiring all required resource instances.*

Day 6 Quiz

1. Which layer of the OSI model handles framing and MAC addressing?

a) Physical
b) Data Link
c) Network
d) Transport

2. A VPN primarily provides:

a) Faster download speeds always
b) A secure, encrypted tunnel over a public network
c) Free internet access
d) Automatic virus removal

Answer Key

1-b 2-b

Week 9 Mock Test

Two short tests to close out Week 9: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 9 Only

1. In the OSI model, which layer is responsible for routing?
a) Physical
b) Data Link
c) Network
d) Transport

2. HTTP operates primarily at which OSI layer?
a) Transport
b) Application
c) Network
d) Session

3. DNS is primarily used to:
a) Encrypt data
b) Translate domain names to IP addresses
c) Assign MAC addresses
d) Route packets physically

4. In TCP/IP, which protocol guarantees reliable delivery?
a) UDP
b) IP
c) TCP
d) ICMP

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a) 255.0.0.0
b) 255.255.0.0
c) 255.255.255.0
d) 255.255.255.255

6. Which layer of the OSI model handles framing and MAC addressing?
a) Physical
b) Data Link
c) Network
d) Transport

7. UDP is preferred over TCP when:
a) Reliability matters most
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8. DNS stands for:
a) Domain Name System
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9. HTTPS differs from HTTP mainly by adding:
a) Faster speed
b) Encryption via TLS/SSL
c) A different port only
d) Compression only

10. Which OSI layer is responsible for end-to-end reliable delivery?
a) Network
b) Transport
c) Session
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a) The physical length of a cable
b) The maximum data transfer rate of a connection
c) The number of connected devices
d) The IP address range

14. A MAC address operates primarily at which layer?
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b) Data Link
c) Transport
d) Session

15. Port 443 is commonly associated with:
a) HTTP
b) HTTPS
c) FTP
d) DNS

16. A router's main job is to:
a) Store files
b) Forward packets between networks
c) Render web pages
d) Compile code

Answer Key

1-c 2-b 3-b 4-c 5-c 6-b 7-b 8-a 9-b 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-9

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
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4. Which keyword is used to define a function in Python?
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5. Recursion always requires a:
a) loop
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6. Which of the following is an example of polymorphism?
a) Method overloading
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c) Method definition
d) Both a and b

7. Which data structure follows LIFO order?
a) Queue

b) Stack
c) Array
d) Linked list

8. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

9. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

10. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

11. Which sorting algorithm has the best average time complexity?
a) Bubble sort
b) Selection sort
c) Quick sort
d) Insertion sort

12. In-order traversal of a Binary Search Tree gives elements in:
a) Random order
b) Sorted order
c) Reverse order
d) Level order

13. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

14. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

15. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)

c) O(n)
d) O(n²)

16. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

17. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

18. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
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19. An INNER JOIN returns:
a) All rows from both tables
b) Only matching rows from both tables
c) All rows from the left table only
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20. Indexing in a database primarily improves:
a) Data security
b) Query performance
c) Data redundancy
d) Normalization

21. A transaction that has completed all operations but not yet committed is in the:
a) Active state
b) Partially committed state
c) Committed state
d) Failed state

22. Which OS scheduling algorithm can cause starvation?
a) Round Robin
b) Shortest Job First
c) FCFS
d) None of the above

23. A deadlock occurs when:
a) Processes wait indefinitely for resources held by each other
b) A process completes normally
c) CPU is idle

d) Memory is full

24. Which of these is NOT one of the four necessary conditions for deadlock?

a) Mutual exclusion
b) Hold and wait
c) Preemption
d) Circular wait

25. In the OSI model, which layer is responsible for routing?

a) Physical
b) Data Link
c) Network
d) Transport

26. HTTP operates primarily at which OSI layer?

a) Transport
b) Application
c) Network
d) Session

27. DNS is primarily used to:

a) Encrypt data
b) Translate domain names to IP addresses
c) Assign MAC addresses
d) Route packets physically

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d 7-b 8-b 9-b 10-b 11-c 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b 22-b 23-a 24-c 25-c 26-b 27-b

Week 10: Software Engineering & Machine Learning Basics

Use this log to track your Computer Science & Information Technology study sessions for Week 10. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — SDLC Models

SDLC Models

The Software Development Life Cycle (SDLC) is the structured process of planning, building, and maintaining software. Waterfall: strictly sequential phases (requirements → design → implementation → testing → deployment → maintenance), best when requirements are certain and unlikely to change. Agile: iterative, incremental delivery in short cycles ('sprints'), embracing changing requirements — Scrum and Kanban are popular Agile frameworks. Spiral: combines iterative development with explicit risk analysis at each cycle, suited to large, high-risk projects.

Additional Practice Example: What is the output of 'print(type(5/2))' in Python 3?
Solution: *In Python 3, the / operator always performs true (float) division, so 5/2 = 2.5, and type(2.5) is <class 'float'>.*

Day 1 Quiz

1. Which SDLC model follows a strictly sequential approach?
a) Agile
b) Waterfall
c) Spiral
d) Prototyping

2. Which phase of SDLC translates non-technical requirements into technical requirements?
a) Planning
b) Analysis
c) Feasibility study
d) Design

3. A feature in machine learning refers to:
a) The final prediction
b) An input variable used by the model
c) The loss function
d) The programming language used

Answer Key

1-b 2-b 3-b

Day 2 — SDLC Models

SDLC Models

Software testing types include unit testing (individual components), integration testing (components working together), and system testing (the whole system against requirements).

Additional Practice Example: A table has 1 million rows and no index on a frequently filtered column. What's the likely consequence?

Solution: *Without an index, queries filtering on that column require a full table scan, checking all 1 million rows — this is significantly slower than an indexed lookup, especially as the table grows.*

Day 2 Quiz

1. Which model is best suited for projects with well-defined, unchanging requirements?
a) Agile
b) Waterfall
c) Scrum
d) Kanban

2. Underfitting is best described as:
a) A model too complex for the data
b) A model too simple to capture the pattern
c) Perfect model performance
d) A data storage issue

3. Unsupervised learning is used when data is:
a) Fully labeled
b) Unlabeled
c) Always numeric
d) Always categorical

Answer Key

1-b 2-b 3-b

Day 3 — Machine Learning Basics

Machine Learning Basics

Supervised learning trains a model on labeled data (input-output pairs) to predict outputs for new inputs — includes classification (predicting a category, e.g. spam/not spam) and regression (predicting a continuous value, e.g. house price). Unsupervised learning works with unlabeled data to find structure — clustering (grouping similar points, e.g. K-means) is the classic example.

Additional Practice Example: Convert the decimal number 25 to binary.
Solution: *25 = 16+8+1 = $2^4+2^3+2^0$, so in binary: 11001.*

Day 3 Quiz

1. Supervised learning requires:
a) Only input data
b) Labeled input-output pairs
c) No data
d) Only unlabeled data

2. Regression in machine learning predicts:
a) A category/class
b) A continuous numeric value
c) Cluster membership only
d) Nothing quantifiable

3. A 'sprint' in Agile typically lasts:
a) One day
b) A few weeks
c) A full year
d) One hour

Answer Key

1-b 2-b 3-b

Day 4 — Machine Learning Basics

Machine Learning Basics

Overfitting occurs when a model learns the training data too closely (including its noise), performing well on training data but poorly on new, unseen data — mitigated by techniques like regularization, cross-validation, and simplifying the model. Underfitting is the opposite: the model is too simple to capture the underlying pattern, performing poorly on both training and test data.

Additional Practice Example: A linked list has a bug causing infinite traversal. What is the most likely cause?
Solution: *The most likely cause is a cycle in the list — a node's 'next' pointer incorrectly points back to an earlier node instead of eventually reaching a null terminator, so traversal never ends.*

Day 4 Quiz

1. Clustering is an example of:
a) Supervised learning
b) Unsupervised learning
c) Reinforcement learning
d) Regression

2. Agile development is characterized by:
a) Long, rigid sequential phases
b) Iterative, incremental delivery in short cycles
c) No testing phase
d) A single final release only

3. Cross-validation helps estimate a model's performance on:
a) Only training data
b) Unseen data more reliably
c) Nothing useful
d) Only categorical data

Answer Key

1-b 2-b 3-b

Day 5 — SDLC Models (Review)

SDLC Models

The Software Development Life Cycle (SDLC) is the structured process of planning, building, and maintaining software. Waterfall: strictly sequential phases (requirements → design → implementation → testing → deployment → maintenance), best when requirements are certain and unlikely to change. Agile: iterative, incremental delivery in short cycles ('sprints'), embracing changing requirements — Scrum and Kanban are popular Agile frameworks. Spiral: combines iterative development with explicit risk analysis at each cycle, suited to large, high-risk projects.

Additional Practice Example: Convert the decimal number 45 to binary.
Solution: *45 = 32+8+4+1 = $2^5+2^3+2^2+2^0$, giving binary 101101.*

Day 5 Quiz

1. In machine learning, overfitting occurs when a model:
a) Performs well on training but poorly on new data
b) Performs poorly on all data
c) Cannot be trained
d) Has too few parameters

2. A/B testing in software development is used to:
a) Compare two versions to see which performs better with users
b) Test only for bugs
c) Replace unit testing entirely
d) Encrypt user data

Answer Key

1-a 2-a

Day 6 — SDLC Models (Review)

SDLC Models

Software testing types include unit testing (individual components), integration testing (components working together), and system testing (the whole system against requirements).

Additional Practice Example: A function is called with the same input twice. What caching technique avoids redundant computation?

Solution: *Memoization — storing previously computed results keyed by input, and returning the cached result on repeat calls.*

Day 6 Quiz

1. The Spiral model is best suited for:

a) Small, low-risk projects
b) Large, high-risk projects with explicit risk analysis
c) Only web applications
d) Only mobile apps

2. Cross-validation in machine learning helps to:

a) Guarantee zero error
b) Get a more reliable estimate of model performance on unseen data
c) Speed up training only
d) Eliminate the need for test data forever

Answer Key

1-b 2-b

Week 10 Mock Test

Two short tests to close out Week 10: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 10 Only

1. Which SDLC model follows a strictly sequential approach?
a) Agile
b) Waterfall
c) Spiral
d) Prototyping

2. Which model is best suited for projects with well-defined, unchanging requirements?
a) Agile
b) Waterfall
c) Scrum
d) Kanban

3. Supervised learning requires:
a) Only input data
b) Labeled input-output pairs
c) No data
d) Only unlabeled data

4. Clustering is an example of:
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a) Guarantee zero error
b) Get a more reliable estimate of model performance on unseen data
c) Speed up training only
d) Eliminate the need for test data forever

13. A feature in machine learning refers to:
a) The final prediction
b) An input variable used by the model
c) The loss function
d) The programming language used

14. Unsupervised learning is used when data is:
a) Fully labeled
b) Unlabeled
c) Always numeric
d) Always categorical

15. A 'sprint' in Agile typically lasts:
a) One day
b) A few weeks
c) A full year
d) One hour

16. Cross-validation helps estimate a model's performance on:
a) Only training data
b) Unseen data more reliably
c) Nothing useful
d) Only categorical data

Answer Key

1-b	*2-b*	*3-b*	*4-b*	*5-a*	*6-b*	*7-b*	*8-b*	*9-b*	*10-b*	*11-a*	*12-b*	*13-b*	*14-b*	*15-b*	*16-b*

Part B — Cumulative, Weeks 1-10

1. Which of the following is a valid Python variable name?
a) 2var
b) var_2
c) var-2
d) var 2

2. The output of print(3 + 2 * 2) in Python is:
a) 10
b) 7
c) 12
d) 9

3. Python is best described as:
a) Statically typed
b) Dynamically typed
c) Not typed at all
d) Only integer-typed

4. Which keyword is used to define a function in Python?
a) func
b) def
c) function
d) define

5. Recursion always requires a:
a) loop
b) base case
c) global variable
d) class

6. Which of the following is an example of polymorphism?
a) Method overloading
b) Method overriding
c) Method definition
d) Both a and b

7. Which data structure follows LIFO order?
a) Queue

b) Stack
c) Array
d) Linked list

8. Which data structure follows FIFO order?
a) Stack
b) Queue
c) Tree
d) Graph

9. Random access (by index) in O(1) time is a feature of:
a) Linked lists
b) Arrays
c) Stacks
d) Queues

10. A binary tree node has at most:
a) 1 child
b) 2 children
c) 3 children
d) unlimited children

11. Which sorting algorithm has the best average time complexity?
a) Bubble sort
b) Selection sort
c) Quick sort
d) Insertion sort

12. In-order traversal of a Binary Search Tree gives elements in:
a) Random order
b) Sorted order
c) Reverse order
d) Level order

13. Binary search requires the array to be:
a) Random
b) Sorted
c) Unsorted
d) Circular

14. The time complexity of binary search is:
a) O(n)
b) O(log n)
c) $O(n^2)$
d) O(1)

15. The time complexity of linear search in the worst case is:
a) O(1)
b) O(log n)

c) O(n)
d) $O(n^2)$

16. In SQL, which clause filters groups after aggregation?
a) WHERE
b) HAVING
c) GROUP BY
d) ORDER BY

17. A primary key must be:
a) Nullable
b) Unique and not null
c) Repeated
d) Optional

18. Which of the following statements is true?
a) A relation can have only one primary key
b) A relation can have only one foreign key
c) A relation can have only one super key
d) A relation can have only one candidate key

19. An INNER JOIN returns:
a) All rows from both tables
b) Only matching rows from both tables
c) All rows from the left table only
d) No rows

20. Indexing in a database primarily improves:
a) Data security
b) Query performance
c) Data redundancy
d) Normalization

21. A transaction that has completed all operations but not yet committed is in the:
a) Active state
b) Partially committed state
c) Committed state
d) Failed state

22. Which OS scheduling algorithm can cause starvation?
a) Round Robin
b) Shortest Job First
c) FCFS
d) None of the above

23. A deadlock occurs when:
a) Processes wait indefinitely for resources held by each other
b) A process completes normally
c) CPU is idle

d) Memory is full

24. Which of these is NOT one of the four necessary conditions for deadlock?
a) Mutual exclusion
b) Hold and wait
c) Preemption
d) Circular wait

25. In the OSI model, which layer is responsible for routing?
a) Physical
b) Data Link
c) Network
d) Transport

26. HTTP operates primarily at which OSI layer?
a) Transport
b) Application
c) Network
d) Session

27. DNS is primarily used to:
a) Encrypt data
b) Translate domain names to IP addresses
c) Assign MAC addresses
d) Route packets physically

28. Which SDLC model follows a strictly sequential approach?
a) Agile
b) Waterfall
c) Spiral
d) Prototyping

29. Which model is best suited for projects with well-defined, unchanging requirements?
a) Agile
b) Waterfall
c) Scrum
d) Kanban

30. Supervised learning requires:
a) Only input data
b) Labeled input-output pairs
c) No data
d) Only unlabeled data

Answer Key

1-b 2-b 3-b 4-b 5-b 6-d 7-b 8-b 9-b 10-b 11-c 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b 22-b 23-a 24-c 25-c 26-b 27-b 28-b 29-b 30-b

Computer Science & Information Technology — Solved Problem Bank

A set of fully worked problems spanning the whole subject, useful for a final confidence check before moving to the next part. Try each problem yourself before reading the solution.

Problem 1: Trace the output of: for i in range(3): print(i).

Solution: *range(3) generates 0, 1, 2. The loop prints each on its own line: 0, then 1, then 2.*

Problem 2: What is the time complexity of nested loops, each running n times?

Solution: *Each outer iteration runs the inner loop n times, and there are n outer iterations, giving $n \times n = O(n^2)$.*

Problem 3: Convert the binary number 1011 to decimal.

Solution: *$1011 = 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 = 8+0+2+1 = 11$.*

Problem 4: A stack has push order A, B, C. What is the pop order?

Solution: *A stack is LIFO, so the last pushed is popped first: the pop order is C, B, A.*

Problem 5: Design a simple ER relationship: a Student enrolls in many Courses, and a Course has many Students. What type of relationship is this?

Solution: *This is a many-to-many relationship, typically implemented in a relational database using a junction/bridge table containing foreign keys to both Student and Course.*

Problem 6: Write the SQL to select all employees earning more than 50000.

Solution: *SELECT * FROM Employees WHERE salary > 50000;*

Problem 7: Normalize a table Orders(OrderID, CustomerName, CustomerAddress, ProductID, ProductPrice) — what redundancy exists?

Solution: *CustomerName and CustomerAddress repeat for every order the same customer places, and ProductPrice repeats for every order of the same product — both are redundancies removable by splitting into separate Customer and Product tables linked via foreign keys (3NF).*

Problem 8: Given processes with burst times P1=5, P2=3, P3=8, find average waiting time using SJF (non-preemptive).

Solution: *SJF order: P2(3), P1(5), P3(8). Waiting times: P2=0, P1=3, P3=8. Average = (0+3+8)/3 = 3.67.*

Problem 9: How many bits are needed to represent 100 distinct values?

Solution: *$2^7=128 \geq 100 > 2^6=64$, so 7 bits are required (7 bits can represent up to 128 distinct values).*

Problem 10: A binary search tree has values 50, 30, 70, 20, 40. What does in-order traversal produce?

Solution: *In-order visits left-subtree, node, right-subtree recursively, producing sorted order: 20, 30, 40, 50, 70.*

Problem 11: Compute the subnet mask for a Class C network split into 4 subnets.

Solution: *4 subnets need 2 extra bits ($2^2=4$), so the mask extends from /24 to /26: 255.255.255.192.*

Problem 12: What does the SQL query 'SELECT COUNT(*) FROM Orders WHERE Status="Shipped"' return?

Solution: *It returns the count (a single number) of rows in the Orders table where the Status column equals 'Shipped'.*

Problem 13: A recursive function to compute Fibonacci(n) is defined without memoization. Why is this inefficient for large n?

Solution: *Without memoization, the same sub-problems (e.g. Fibonacci(3)) are recomputed many times across different recursive branches, leading to exponential time complexity $O(2^n)$ instead of the achievable O(n) with memoization or iteration.*

Problem 14: A hash table has 10 buckets and stores 15 items. What does this imply about collisions?

Solution: *By the pigeonhole principle, since 15 items exceed 10 buckets, at least one bucket must contain more than one item — collisions are guaranteed.*

Problem 15: Identify the OSI layer responsible for translating IP addresses into physical (MAC) addresses via ARP.

Solution: *This function bridges the Network layer (which uses IP addresses) and the Data Link layer (which uses MAC addresses); ARP itself operates as a Network/Data-Link boundary protocol, most commonly associated with the Data Link layer's addressing function.*

Problem 16: Trace through: x = 5; x = x + 3; print(x). What is printed?

Solution: *x starts at 5, then x = x+3 reassigns x to 5+3 = 8. The output is 8.*

Problem 17: A queue-based BFS explores a graph starting at node A with neighbors B, C. What is visited first after A?

Solution: *BFS visits neighbors in the order they were enqueued; since B and C are both enqueued after A, B (enqueued first, assuming that order) is dequeued and visited next.*

Problem 18: Why is quicksort's worst case $O(n^2)$ despite averaging O(n log n)?

Solution: *Quicksort's worst case occurs when the chosen pivot is consistently the smallest or largest element (e.g. an already sorted array with a naive pivot choice), causing the partitions to be maximally unbalanced (size 1 and n-1) at every step, leading to n levels of O(n) work each.*

Problem 19: Compute how many rows a CROSS JOIN of a 4-row table and a 3-row table produces.

Solution: *A CROSS JOIN produces the Cartesian product: every row of the first table paired with every row of the second, giving $4 \times 3 = 12$ rows.*

Problem 20: A process needs 3 resource instances but only 2 are currently free. What state does it enter?

Solution: *The process enters the Waiting/Blocked state, since it cannot proceed without acquiring all required resource instances.*

Problem 21: What is the output of 'print(type(5/2))' in Python 3?

Solution: *In Python 3, the / operator always performs true (float) division, so 5/2 = 2.5, and type(2.5) is <class 'float'>.*

Problem 22: A table has 1 million rows and no index on a frequently filtered column. What's the likely consequence?

Solution: *Without an index, queries filtering on that column require a full table scan, checking all 1 million rows — this is significantly slower than an indexed lookup, especially as the table grows.*

Problem 23: Convert the decimal number 25 to binary.

Solution: *$25 = 16+8+1 = 2^4+2^3+2^0$, so in binary: 11001.*

Problem 24: A linked list has a bug causing infinite traversal. What is the most likely cause?

Solution: *The most likely cause is a cycle in the list — a node's 'next' pointer incorrectly points back to an earlier node instead of eventually reaching a null terminator, so traversal never ends.*

Problem 25: Convert the decimal number 45 to binary.

Solution: *$45 = 32+8+4+1 = 2^5+2^3+2^2+2^0$, giving binary 101101.*

Problem 26: A function is called with the same input twice. What caching technique avoids redundant computation?

Solution: *Memoization — storing previously computed results keyed by input, and returning the cached result on repeat calls.*

Problem 27: What SQL clause sorts query results?

Solution: *ORDER BY, optionally with ASC (default) or DESC.*

Problem 28: A website response takes 200ms on average with a cache, and 2000ms without. What speedup factor does the cache provide?

Solution: *2000/200 = 10x speedup.*

Problem 29: Which is faster for searching a sorted 1-million-element array: linear or binary search, and by roughly what factor?

Solution: *Binary search, requiring about $\log_2(1{,}000{,}000) \approx 20$ comparisons versus up to 1,000,000 for linear search — roughly a 50,000x improvement in the worst case.*

Problem 30: A relational table violates 1NF because a column stores comma-separated multiple values. How is this fixed?

Solution: *Split the multi-valued column into a separate related table (or separate rows), so each cell holds a single atomic value.*

Problem 31: What does 'idempotent' mean for an HTTP method like GET or PUT?

Solution: *Calling it multiple times has the same effect as calling it once — repeating the request doesn't change the outcome further.*

Problem 32: A process is scheduled with time quantum 4ms and needs 10ms of CPU time under Round Robin. How many time slices does it need?

Solution: *10/4 = 2.5, rounded up to 3 time slices (the last slice uses only 2ms).*

Problem 33: Why is a linked list generally preferred over an array for a queue used in producer-consumer scenarios with unknown size?

Solution: *A linked list grows dynamically without needing to pre-allocate or resize, unlike a fixed-size array.*

Problem 34: What is the output of 5 // 2 in Python?

Solution: *Floor division: 5 // 2 = 2 (rounds down to the nearest integer).*

Computer Science & Information Technology — Glossary of Key Terms

A quick-reference glossary. Read through it once, then use it to test yourself: cover the definitions and try to recall each one from the term alone.

Term	Definition
API	Application Programming Interface; a defined set of methods for software components to communicate.
B-Tree	A self-balancing tree data structure commonly used to implement database indexes for fast lookups.
Cache	A small, fast storage layer that keeps frequently accessed data close to the processor to speed up access.
Class (OOP)	A blueprint defining the attributes and methods that objects of that type will have.
Deadlock	A state where two or more processes are each waiting for a resource held by another, so none can proceed.
Encapsulation	Bundling data and the methods that operate on it, while restricting direct access to internal details.
Foreign Key	A column (or set of columns) in one table that references the primary key of another table.
Hash Table	A data structure that maps keys to values using a hash function for near-constant-time lookup.
Index (Database)	A data structure that improves the speed of data retrieval on a table, at some cost to write performance.
Kernel	The core component of an operating system, managing hardware resources and process scheduling.
Latency	The time delay between a request being sent and a response being received.
Normalization	The process of organizing database tables to reduce redundancy and improve data integrity.
Overfitting	When a machine learning model fits training data too closely, harming its performance on new data.
Packet	A unit of data formatted for transmission across a network.
Recursion	A programming technique where a function calls itself to solve smaller instances of a problem.
Scheduling (CPU)	The method by which an operating system decides which process runs on the CPU at a given time.
Stack Overflow	An error occurring when a program's call stack exceeds its allocated memory, often due to uncontrolled recursion.
Thread	A lightweight unit of execution within a process, sharing the process's memory space.
Transaction	A sequence of database operations treated as a single, indivisible unit satisfying ACID properties.
Virtual Memory	A memory management technique giving programs the illusion of a large, contiguous memory space, backed by disk storage.
Big-O Notation	A mathematical notation describing the upper-bound growth rate of an algorithm's time or space requirements.
Binary Search	A search algorithm that repeatedly halves a sorted range to locate a target value in O(log n) time.
Inheritance	An OOP mechanism where a class derives attributes and methods from a parent class.
OSI Model	A conceptual 7-layer framework describing how data is transmitted across a network.

Polymorphism	An OOP feature allowing the same method name to behave differently depending on the calling object.
SDLC	Software Development Life Cycle; the structured process of planning, building, and maintaining software.
Memoization	An optimization technique that caches the results of expensive function calls to avoid redundant computation.
Idempotent	An operation that produces the same result no matter how many times it is performed.
Time Quantum	The fixed time slice allocated to a process in Round Robin CPU scheduling.
Cache	A fast, small storage layer holding frequently accessed data to reduce access time.
Atomic Value	A single, indivisible data value, as required in First Normal Form (1NF).

PART 4

Technical English

Technical English carries only 10 of the 100 marks, but its questions are usually quick to answer once the underlying grammar rule is known — making it one of the highest value-per-minute sections if you prepare it properly. This part covers grammar, vocabulary, and reading comprehension organized week by week.

This part is organized as 10 weeks of 6 study days each (60 days total), matching a Monday-to-Saturday study rhythm with Sunday reserved for mixed review across all five subjects (see Part 6).

Week 1: Parts of Speech & Vocabulary Building

Use this log to track your Technical English study sessions for Week 1. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Parts of Speech

Parts of Speech

The eight parts of speech: Noun (person/place/thing/idea), Pronoun (replaces a noun — he, she, it), Verb (action/state), Adjective (describes a noun), Adverb (describes a verb/adjective/other adverb, often ending in -ly), Preposition (shows relationship — in, on, at, under), Conjunction (joins words/clauses — and, but, because), Interjection (expresses emotion — Wow!).

Additional Practice Example: Convert to passive voice: 'The committee will announce the results tomorrow.'

Solution: *Identify the object (the results) as the new subject, use 'will be' + past participle, and optionally add the agent: 'The results will be announced by the committee tomorrow.'*

Day 1 Quiz

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. Which of these is a preposition?
a) Run
b) Happily
c) Under
d) And

3. Which word is an adverb of frequency?
a) Quickly
b) Always
c) Beautiful
d) Under

Answer Key

1-b 2-c 3-b

Day 2 — Parts of Speech

Parts of Speech

Identifying the part of speech of an underlined word in context is a common question format — the same word can function differently in different sentences (e.g. 'work' can be a noun or a verb).

Additional Practice Example: Convert to indirect speech: He said, "I have finished my homework."

Solution: *The reporting verb 'said' is past tense, so present perfect ('have finished') shifts to past perfect: 'He said that he had finished his homework.'*

Day 2 Quiz

1. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):

a) Noun
b) Adjective
c) Adverb
d) Preposition

2. The word closest in meaning to 'Ubiquitous' is:

a) Rare
b) Present everywhere
c) Ancient
d) Unclear

3. A word describing an action or state is a:

a) Noun
b) Verb
c) Adjective
d) Preposition

Answer Key

1-c 2-b 3-b

Day 3 — Vocabulary Building Strategy

Vocabulary Building Strategy

Learn 15 new words a day using this cycle: see the word in a sentence, write your own sentence using it, and review it again after 24 hours and after a week (spaced repetition). Prioritize words that appear frequently in academic and scientific writing, since MDS-level English draws on formal/technical register rather than casual speech.

Additional Practice Example: Identify and correct the error: 'Between you and I, this is a great idea.'

Solution: *Prepositions like 'between' take object pronouns, not subject pronouns — 'I' should be 'me': 'Between you and me, this is a great idea.'*

Day 3 Quiz

1. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

2. The word closest in meaning to 'Feasible' is:
a) Impossible
b) Workable/achievable
c) Expensive
d) Delayed

3. Choose correct plural: 'mouse' (animal) becomes:
a) mouses
b) mice
c) mouse's
d) mousen

Answer Key

1-c 2-b 3-b

Day 4 — Vocabulary Building Strategy

Vocabulary Building Strategy

Useful high-frequency academic words to know: abundant, meticulous, ubiquitous, arbitrary, coherent, feasible, plausible, redundant, robust, significant, subsequent, adequate, comprehensive, inherent, substantial.

Additional Practice Example: Choose the correct word: 'The effect/affect of the new policy was significant.'

Solution: *'Effect' is normally a noun meaning result; 'affect' is normally a verb meaning to influence. Since a noun is needed here, the correct choice is 'effect.'*

Day 4 Quiz

1. Which word functions as a conjunction?
a) Quickly
b) Because
c) Under
d) Beautiful

2. A pronoun is a word that:
a) Describes a verb
b) Replaces a noun
c) Joins two clauses
d) Shows emotion

3. 'Quickly' answers the question:
a) What?
b) How?
c) Who?
d) Where?

Answer Key

1-b 2-b 3-b

Day 5 — Parts of Speech (Review)

Parts of Speech

The eight parts of speech: Noun (person/place/thing/idea), Pronoun (replaces a noun — he, she, it), Verb (action/state), Adjective (describes a noun), Adverb (describes a verb/adjective/other adverb, often ending in -ly), Preposition (shows relationship — in, on, at, under), Conjunction (joins words/clauses — and, but, because), Interjection (expresses emotion — Wow!).

Additional Practice Example: Identify the figure of speech in: 'The stars danced in the night sky.'

Solution: *Giving human actions (dancing) to non-human things (stars) is personification.*

Day 5 Quiz

1. "Wow, that's amazing!" The word 'Wow' is a(n):

a) Noun
b) Interjection
c) Adverb
d) Pronoun

2. Which of these is a proper noun?

a) city
b) Kathmandu
c) happiness
d) run

Answer Key

1-b 2-b

Day 6 — Parts of Speech (Review)

Parts of Speech

Identifying the part of speech of an underlined word in context is a common question format — the same word can function differently in different sentences (e.g. 'work' can be a noun or a verb).

Additional Practice Example: Correct the sentence: 'Neither the teacher nor the students was ready.'

Solution: *When 'neither...nor' joins a singular and plural subject, the verb agrees with the nearer subject — 'students' (plural), so the verb should be 'were': 'Neither the teacher nor the students were ready.'*

Day 6 Quiz

1. A word that describes a noun is called a(n):
a) Verb
b) Adjective
c) Preposition
d) Conjunction

2. Choose the correct plural: 'child' becomes:
a) childs
b) childes
c) children
d) childrens

Answer Key

1-b 2-c

Week 1 Mock Test

Two short tests to close out Week 1: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 1 Only

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Which word functions as a conjunction?
a) Quickly
b) Because
c) Under
d) Beautiful

5. "Wow, that's amazing!" The word 'Wow' is a(n):
a) Noun
b) Interjection
c) Adverb
d) Pronoun

6. A word that describes a noun is called a(n):
a) Verb
b) Adjective
c) Preposition
d) Conjunction

7. Which of these is a preposition?
a) Run
b) Happily

c) Under
d) And

8. The word closest in meaning to 'Ubiquitous' is:
a) Rare
b) Present everywhere
c) Ancient
d) Unclear

9. The word closest in meaning to 'Feasible' is:
a) Impossible
b) Workable/achievable
c) Expensive
d) Delayed

10. A pronoun is a word that:
a) Describes a verb
b) Replaces a noun
c) Joins two clauses
d) Shows emotion

11. Which of these is a proper noun?
a) city
b) Kathmandu
c) happiness
d) run

12. Choose the correct plural: 'child' becomes:
a) childs
b) childes
c) children
d) childrens

13. Which word is an adverb of frequency?
a) Quickly
b) Always
c) Beautiful
d) Under

14. A word describing an action or state is a:
a) Noun
b) Verb
c) Adjective
d) Preposition

15. Choose correct plural: 'mouse' (animal) becomes:
a) mouses
b) mice
c) mouse's

d) mousen

16. 'Quickly' answers the question:

a) What?
b) How?
c) Who?
d) Where?

Answer Key

1-b 2-c 3-c 4-b 5-b 6-b 7-c 8-b 9-b 10-b 11-b 12-c 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-1

1. Choose the correctly spelled word:

a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):

a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."

a) Noun
b) Verb
c) Adverb
d) Preposition

Answer Key

1-b 2-c 3-c

Week 2: Tenses

Use this log to track your Technical English study sessions for Week 2. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — The Twelve Tenses

The Twelve Tenses

English has 3 main time frames (past, present, future) × 4 aspects (simple, continuous, perfect, perfect continuous) = 12 tenses. Simple tenses state a fact/habit (She goes / She went / She will go). Continuous tenses show an ongoing action (She is going / She was going / She will be going). Perfect tenses show completion relative to another point (She has gone / She had gone / She will have gone). Perfect continuous shows a duration up to a point (She has been going / She had been going / She will have been going).

Additional Practice Example: Convert to active voice: 'The novel was written by an unknown author in 1850.'

Solution: *Make the original agent the subject and the object of the passive sentence the new object: 'An unknown author wrote the novel in 1850.'*

Day 1 Quiz

1. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

2. "They ___ dinner when the power went out." (best fit)
a) eat
b) ate
c) were eating
d) have eaten

3. 'While she ___ , the phone rang.' (past continuous)
a) cooked
b) was cooking
c) cooks
d) has cooked

Answer Key

1-b 2-c 3-b

Day 2 — The Twelve Tenses

The Twelve Tenses

Subject-verb agreement is the single most tested grammar rule: singular subjects take singular verbs (he goes), plural subjects take plural verbs (they go). Watch for tricky cases: 'Each of the students HAS' (each is singular), and 'Neither the manager nor the assistants KNOW' (verb agrees with the noun closest to it).

Additional Practice Example: Identify the correctly punctuated sentence among: (a) Its raining, (b) It's raining.

Solution: *'It's' is the contraction of 'it is,' which fits the intended meaning here, so (b) 'It's raining' is correct; 'Its' (no apostrophe) is a possessive pronoun and would be wrong in this context.*

Day 2 Quiz

1. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

2. Subject-verb agreement means:
a) The subject and verb must rhyme
b) A singular subject takes a singular verb form
c) All verbs are the same regardless of subject
d) Only plural subjects need agreement

3. 'They ___ (live) here for ten years.' (present perfect)
a) live
b) lived
c) have lived
d) living

Answer Key

1-b 2-b 3-c

Day 3 — The Twelve Tenses (Review)

The Twelve Tenses

English has 3 main time frames (past, present, future) × 4 aspects (simple, continuous, perfect, perfect continuous) = 12 tenses. Simple tenses state a fact/habit (She goes / She went / She will go). Continuous tenses show an ongoing action (She is going / She was going / She will be going). Perfect tenses show completion relative to another point (She has gone / She had gone / She will have gone). Perfect continuous shows a duration up to a point (She has been going / She had been going / She will have been going).

Additional Practice Example: Find a synonym for 'meticulous' from context: 'She meticulously checked every line of code before submitting.'

Solution: *The context (checking every line carefully) supports 'careful and precise' as the meaning — synonyms include thorough, careful, precise, painstaking.*

Day 3 Quiz

1. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

2. "I ___ here since 2020." (present perfect continuous)
a) live
b) have been living
c) was living
d) will live

3. Choose correct: 'By the time you arrive, I ___ leave.'
a) will
b) will have left
c) left
d) leave

Answer Key

1-c 2-b 3-b

Day 4 — The Twelve Tenses (Review)

The Twelve Tenses

Subject-verb agreement is the single most tested grammar rule: singular subjects take singular verbs (he goes), plural subjects take plural verbs (they go). Watch for tricky cases: 'Each of the students HAS' (each is singular), and 'Neither the manager nor the assistants KNOW' (verb agrees with the noun closest to it).

Additional Practice Example: Convert direct to indirect: She asked, "Can you help me?"
Solution: *Yes/no questions in indirect speech use 'if' or 'whether,' drop the question mark, and remove inversion: 'She asked if I could help her.'*

Day 4 Quiz

1. The present perfect tense is used to show:
a) An action happening right now
b) A completed action with present relevance
c) A habitual action
d) A future plan

2. Which is a simple past tense sentence?
a) She walks to school
b) She walked to school
c) She is walking to school
d) She will walk to school

3. 'She ___ TV when I called.' (past continuous)
a) watched
b) was watching
c) watches
d) has watched

Answer Key

1-b 2-b 3-b

Day 5 — The Twelve Tenses (Review)

The Twelve Tenses

English has 3 main time frames (past, present, future) × 4 aspects (simple, continuous, perfect, perfect continuous) = 12 tenses. Simple tenses state a fact/habit (She goes / She went / She will go). Continuous tenses show an ongoing action (She is going / She was going / She will be going). Perfect tenses show completion relative to another point (She has gone / She had gone / She will have gone). Perfect continuous shows a duration up to a point (She has been going / She had been going / She will have been going).

Additional Practice Example: Identify the error: 'He is one of the best player in the team.'
Solution: *Since 'one of the best' implies a superlative comparison among many, the noun should be plural: 'He is one of the best players in the team.'*

Day 5 Quiz

1. "By next year, she ___ her degree." (future perfect)
a) will complete
b) will have completed
c) completes
d) is completing

2. 'They ___ finished the report by Monday.' (future perfect)
a) will
b) will have
c) have
d) had

Answer Key

1-b 2-b

Day 6 — The Twelve Tenses (Review)

The Twelve Tenses

Subject-verb agreement is the single most tested grammar rule: singular subjects take singular verbs (he goes), plural subjects take plural verbs (they go). Watch for tricky cases: 'Each of the students HAS' (each is singular), and 'Neither the manager nor the assistants KNOW' (verb agrees with the noun closest to it).

Additional Practice Example: Choose the correct word: 'The book, along with the pen and notebook, ___ on the table.' (is/are)

Solution: *The subject is 'the book' (singular); phrases like 'along with...' don't add to the grammatical subject count, so the verb stays singular: 'is'.*

Day 6 Quiz

1. Which sentence uses the past continuous tense correctly?

a) She was studying when I called
b) She studies when I called
c) She has studied when I call
d) She will study when I called

2. Choose correct: 'I ___ my homework already.'

a) did
b) have done
c) doing
d) do

Answer Key

1-a 2-b

Week 2 Mock Test

Two short tests to close out Week 2: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 2 Only

1. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

2. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

3. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

4. The present perfect tense is used to show:
a) An action happening right now
b) A completed action with present relevance
c) A habitual action
d) A future plan

5. "By next year, she ___ her degree." (future perfect)
a) will complete
b) will have completed
c) completes
d) is completing

6. Which sentence uses the past continuous tense correctly?
a) She was studying when I called
b) She studies when I called
c) She has studied when I call
d) She will study when I called

7. "They ___ dinner when the power went out." (best fit)
a) eat
b) ate
c) were eating

d) have eaten

8. Subject-verb agreement means:
a) The subject and verb must rhyme
b) A singular subject takes a singular verb form
c) All verbs are the same regardless of subject
d) Only plural subjects need agreement

9. "I ___ here since 2020." (present perfect continuous)
a) live
b) have been living
c) was living
d) will live

10. Which is a simple past tense sentence?
a) She walks to school
b) She walked to school
c) She is walking to school
d) She will walk to school

11. 'They ___ finished the report by Monday.' (future perfect)
a) will
b) will have
c) have
d) had

12. Choose correct: 'I ___ my homework already.'
a) did
b) have done
c) doing
d) do

13. 'While she ___ , the phone rang.' (past continuous)
a) cooked
b) was cooking
c) cooks
d) has cooked

14. 'They ___ (live) here for ten years.' (present perfect)
a) live
b) lived
c) have lived
d) living

15. Choose correct: 'By the time you arrive, I ___ leave.'
a) will
b) will have left
c) left
d) leave

16. 'She ___ TV when I called.' (past continuous)
a) watched
b) was watching
c) watches
d) has watched

Answer Key

1-b 2-b 3-c 4-b 5-b 6-a 7-c 8-b 9-b 10-b 11-b 12-b 13-b 14-c 15-b 16-b

Part B — Cumulative, Weeks 1-2

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c

Week 3: Voice (Active & Passive)

Use this log to track your Technical English study sessions for Week 3. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Active and Passive Voice

Active and Passive Voice

In active voice, the subject performs the action: 'She writes a letter.' In passive voice, the subject receives the action, formed with a form of 'be' + past participle, and the original subject becomes optional (introduced by 'by'): 'A letter is written by her.'

Additional Practice Example: Correct the sentence: 'She is one of those students who always does the homework.'

Solution: *The relative clause 'who...' refers to 'students' (plural), so the verb should agree with the plural: 'She is one of those students who always do the homework.'*

Day 1 Quiz

1. The passive voice of "She writes a letter" is:
a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

2. Passive voice is most commonly favored in:
a) Casual conversation
b) Scientific/technical writing
c) Poetry only
d) Text messages

3. Passive of 'Someone cleaned the room':
a) The room was cleaned
b) The room cleaned someone
c) The room cleans
d) Someone was cleaned

Answer Key

1-a 2-b 3-a

Day 2 — Active and Passive Voice

Active and Passive Voice

To convert active to passive: (1) the active sentence's object becomes the passive subject, (2) change the verb to 'be + past participle' matching the original tense, (3) the original subject becomes 'by + agent' (often omittable). Passive voice is common in scientific/technical writing to emphasize the action or result rather than who performed it.

Additional Practice Example: Identify the tone of a passage that uses phrases like 'unfortunately' and 'sadly' throughout.
Solution: *Repeated use of negative-connotation adverbs like 'unfortunately' and 'sadly' signals a pessimistic or regretful tone.*

Day 2 Quiz

1. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

2. The active voice of "The book was read by the students" is:
a) The students read the book
b) The book reads the students
c) Students are read by the book
d) The book will read students

3. Passive of 'The manager will review the report':
a) The report will be reviewed by the manager
b) The report reviews the manager
c) The report is reviewed
d) The manager reviewed the report

Answer Key

1-b 2-a 3-a

Day 3 — Active and Passive Voice (Review)

Active and Passive Voice

In active voice, the subject performs the action: 'She writes a letter.' In passive voice, the subject receives the action, formed with a form of 'be' + past participle, and the original subject becomes optional (introduced by 'by'): 'A letter is written by her.'

Additional Practice Example: Choose the correct form: 'If I ___ rich, I would travel the world.' (was/were)

Solution: *This is a hypothetical/subjunctive condition, which conventionally uses 'were' regardless of subject: 'If I were rich...'*

Day 3 Quiz

1. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

2. In passive voice, the 'by + agent' phrase is:
a) Always required
b) Often optional
c) Never used
d) Required only in future tense

3. Passive voice shifts focus to the:
a) Doer of the action
b) Receiver of the action
c) Time of the action
d) Location only

Answer Key

1-b 2-b 3-b

Day 4 — Active and Passive Voice (Review)

Active and Passive Voice

To convert active to passive: (1) the active sentence's object becomes the passive subject, (2) change the verb to 'be + past participle' matching the original tense, (3) the original subject becomes 'by + agent' (often omittable). Passive voice is common in scientific/technical writing to emphasize the action or result rather than who performed it.

Additional Practice Example: Identify the error: 'The number of students are increasing every year.'

Solution: *'The number of' is treated as singular (it's the number, not the students, that is the subject), so the verb should be 'is': 'The number of students is increasing every year.'*

Day 4 Quiz

1. Passive voice is formed using:
a) have + past participle
b) be + past participle
c) be + present participle
d) do + base verb

2. Which is the passive form of "They are building a bridge"?
a) A bridge is being built by them
b) A bridge builds them
c) They build a bridge
d) A bridge was building them

3. Active of 'The cake was baked by her':
a) She baked the cake
b) The cake baked her
c) Her baked the cake
d) The cake bakes her

Answer Key

1-b 2-a 3-a

Day 5 — Active and Passive Voice (Review)

Active and Passive Voice

In active voice, the subject performs the action: 'She writes a letter.' In passive voice, the subject receives the action, formed with a form of 'be' + past participle, and the original subject becomes optional (introduced by 'by'): 'A letter is written by her.'

Additional Practice Example: Convert to passive: 'Someone stole my bicycle last night.'
Solution: *'Someone' becomes the omittable agent, and 'my bicycle' becomes the subject: 'My bicycle was stolen last night.'*

Day 5 Quiz

1. Which sentence is in the passive voice?
a) The dog chased the cat
b) The cat was chased by the dog
c) The dog is chasing the cat
d) The dog will chase the cat

2. Passive of 'The company hired ten new employees':
a) Ten new employees hired the company
b) Ten new employees were hired by the company
c) Ten new employees are hiring the company
d) The company is hired by ten employees

Answer Key

1-b 2-b

Day 6 — Active and Passive Voice (Review)

Active and Passive Voice

To convert active to passive: (1) the active sentence's object becomes the passive subject, (2) change the verb to 'be + past participle' matching the original tense, (3) the original subject becomes 'by + agent' (often omittable). Passive voice is common in scientific/technical writing to emphasize the action or result rather than who performed it.

Additional Practice Example: Identify the error: 'I would rather to go home now.'
Solution: *'Would rather' is followed by a bare infinitive (without 'to'): 'I would rather go home now.'*

Day 6 Quiz

1. In converting active to passive, the object of the active sentence becomes the:
a) Passive object
b) Passive subject
c) Passive verb
d) Agent only

2. Passive is generally avoided when:
a) Emphasizing the receiver of an action
b) Writing very direct, personal narratives
c) Writing scientific reports
d) The doer is unknown

Answer Key

1-b 2-b

Week 3 Mock Test

Two short tests to close out Week 3: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 3 Only

1. The passive voice of "She writes a letter" is:
a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

2. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

3. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

4. Passive voice is formed using:
a) have + past participle
b) be + past participle
c) be + present participle
d) do + base verb

5. Which sentence is in the passive voice?
a) The dog chased the cat
b) The cat was chased by the dog
c) The dog is chasing the cat
d) The dog will chase the cat

6. In converting active to passive, the object of the active sentence becomes the:
a) Passive object
b) Passive subject
c) Passive verb
d) Agent only

7. Passive voice is most commonly favored in:
a) Casual conversation
b) Scientific/technical writing
c) Poetry only

d) Text messages

8. The active voice of "The book was read by the students" is:
a) The students read the book
b) The book reads the students
c) Students are read by the book
d) The book will read students

9. In passive voice, the 'by + agent' phrase is:
a) Always required
b) Often optional
c) Never used
d) Required only in future tense

10. Which is the passive form of "They are building a bridge"?
a) A bridge is being built by them
b) A bridge builds them
c) They build a bridge
d) A bridge was building them

11. Passive of 'The company hired ten new employees':
a) Ten new employees hired the company
b) Ten new employees were hired by the company
c) Ten new employees are hiring the company
d) The company is hired by ten employees

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13. Passive of 'Someone cleaned the room':
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b) The room cleaned someone
c) The room cleans
d) Someone was cleaned

14. Passive of 'The manager will review the report':
a) The report will be reviewed by the manager
b) The report reviews the manager
c) The report is reviewed
d) The manager reviewed the report

15. Passive voice shifts focus to the:
a) Doer of the action
b) Receiver of the action
c) Time of the action
d) Location only

16. Active of 'The cake was baked by her':
a) She baked the cake
b) The cake baked her
c) Her baked the cake
d) The cake bakes her

Answer Key

1-a 2-b 3-b 4-b 5-b 6-b 7-b 8-a 9-b 10-a 11-b 12-b 13-a 14-a 15-b 16-a

Part B — Cumulative, Weeks 1-3

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

7. The passive voice of "She writes a letter" is:

a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b

Week 4: Narration (Direct & Indirect Speech)

Use this log to track your Technical English study sessions for Week 4. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Direct and Indirect Speech

Direct and Indirect Speech

Direct speech quotes the exact words spoken, in quotation marks: He said, "I am tired." Indirect (reported) speech reports the content without quotation marks, typically shifting tense one step back (present → past, past → past perfect) and adjusting pronouns and time/place references (today→that day, here→there, tomorrow→the next day).

Additional Practice Example: Choose the correct word: 'The effect of the medicine was ___ (immediate/immediately).'

Solution: *Since a noun ('effect') needs an adjective to describe it, 'immediate' is correct: 'The effect...was immediate.'*

Day 1 Quiz

1. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

2. Present tense in direct speech generally shifts to ___ in indirect speech (when the reporting verb is past).
a) Future tense
b) Past tense
c) Present perfect only
d) No change

3. In indirect speech, 'this' often changes to:
a) That
b) These
c) It
d) There

Answer Key

1-b 2-b 3-a

Day 2 — Direct and Indirect Speech

Direct and Indirect Speech

When the reporting verb is in the past tense (said, told), the tense inside the reported clause generally shifts back one step. Questions in indirect speech drop the question mark and inversion, and use 'if/whether' for yes/no questions or the original question word (where, why) for wh-questions — with NO 'that' before them.

Additional Practice Example: Convert to passive: 'They are painting the house.'
Solution: *'The house is being painted (by them).'*

Day 2 Quiz

1. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

2. "Today" in direct speech becomes ___ in indirect speech.
a) That day
b) This day
c) Tomorrow
d) Yesterday

3. 'He said, "I don't like it."' becomes:
a) He said that he doesn't like it
b) He said that he didn't like it
c) He says he doesn't like it
d) He said he don't like it

Answer Key

1-b 2-a 3-b

Day 3 — Direct and Indirect Speech

Direct and Indirect Speech

Worked Example: He said, "I am tired." → He said that he was tired. She said, "I will go tomorrow." → She said that she would go the next day. He asked, "Where do you live?" → He asked where I lived (no 'that', no inversion).

Additional Practice Example: Identify the error: 'He is the most cleverest boy in the class.'
Solution: *Using both 'most' and the superlative '-est' together is redundant: it should be either 'the cleverest' or 'the most clever'.*

Day 3 Quiz

1. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

2. Wh-questions in indirect speech are introduced:
a) With 'that' before the question word
b) Directly with the question word, no 'that'
c) With inversion preserved
d) With a question mark retained

3. 'Tomorrow' in reported speech generally becomes:
a) The next day
b) Today
c) Yesterday
d) No change

Answer Key

1-b 2-b 3-a

Day 4 — Direct and Indirect Speech (Review)

Direct and Indirect Speech

Direct speech quotes the exact words spoken, in quotation marks: He said, "I am tired." Indirect (reported) speech reports the content without quotation marks, typically shifting tense one step back (present → past, past → past perfect) and adjusting pronouns and time/place references (today→that day, here→there, tomorrow→the next day).

Additional Practice Example: Choose the correct preposition: 'She succeeded ___ passing the exam.'

Solution: *'Succeed in' is the correct idiomatic pairing: 'She succeeded in passing the exam.'*

Day 4 Quiz

1. In indirect speech, 'here' typically changes to:
a) There
b) Here still
c) Somewhere
d) Nowhere

2. He said, "I can swim." becomes in indirect speech:
a) He said that he can swim
b) He said that he could swim
c) He says he can swim
d) He said he can swim now

3. Reported yes/no questions use:
a) That
b) If/whether
c) What
d) So

Answer Key

1-a 2-b 3-b

Day 5 — Direct and Indirect Speech (Review)

Direct and Indirect Speech

When the reporting verb is in the past tense (said, told), the tense inside the reported clause generally shifts back one step. Questions in indirect speech drop the question mark and inversion, and use 'if/whether' for yes/no questions or the original question word (where, why) for wh-questions — with NO 'that' before them.

Additional Practice Example: Convert to passive voice: 'The committee will announce the results tomorrow.'

Solution: *Identify the object (the results) as the new subject, use 'will be' + past participle, and optionally add the agent: 'The results will be announced by the committee tomorrow.'*

Day 5 Quiz

1. In indirect speech, a yes/no question is introduced using:
a) That
b) If/whether
c) What
d) Because

2. 'He said, "I must leave now."' becomes in indirect speech:
a) He said that he must leave now
b) He said that he had to leave then
c) He said he must leave then
d) He says he must leave now

Answer Key

1-b 2-b

Day 6 — Direct and Indirect Speech (Review)

Direct and Indirect Speech

Worked Example: He said, "I am tired." → He said that he was tired. She said, "I will go tomorrow." → She said that she would go the next day. He asked, "Where do you live?" → He asked where I lived (no 'that', no inversion).

Additional Practice Example: Convert to indirect speech: He said, "I have finished my homework."

Solution: *The reporting verb 'said' is past tense, so present perfect ('have finished') shifts to past perfect: 'He said that he had finished his homework.'*

Day 6 Quiz

1. "I am happy," she said. In indirect speech:
a) She said that she is happy
b) She said that she was happy
c) She says she is happy
d) She said she is being happy

2. 'She said, "This is my book."' becomes:
a) She said that this was her book
b) She said that that was her book
c) She said this is her book
d) She said that was my book

Answer Key

1-b 2-b

Week 4 Mock Test

Two short tests to close out Week 4: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 4 Only

1. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

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a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

3. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

4. In indirect speech, 'here' typically changes to:
a) There
b) Here still
c) Somewhere
d) Nowhere

5. In indirect speech, a yes/no question is introduced using:
a) That
b) If/whether
c) What
d) Because

6. "I am happy," she said. In indirect speech:
a) She said that she is happy
b) She said that she was happy
c) She says she is happy
d) She said she is being happy

7. Present tense in direct speech generally shifts to ___ in indirect speech (when the reporting verb is past).
a) Future tense
b) Past tense

c) Present perfect only
d) No change

8. "Today" in direct speech becomes ___ in indirect speech.
a) That day
b) This day
c) Tomorrow
d) Yesterday

9. Wh-questions in indirect speech are introduced:
a) With 'that' before the question word
b) Directly with the question word, no 'that'
c) With inversion preserved
d) With a question mark retained

10. He said, "I can swim." becomes in indirect speech:
a) He said that he can swim
b) He said that he could swim
c) He says he can swim
d) He said he can swim now

11. 'He said, "I must leave now."' becomes in indirect speech:
a) He said that he must leave now
b) He said that he had to leave then
c) He said he must leave then
d) He says he must leave now

12. 'She said, "This is my book."' becomes:
a) She said that this was her book
b) She said that that was her book
c) She said this is her book
d) She said that was my book

13. In indirect speech, 'this' often changes to:
a) That
b) These
c) It
d) There

14. 'He said, "I don't like it."' becomes:
a) He said that he doesn't like it
b) He said that he didn't like it
c) He says he doesn't like it
d) He said he don't like it

15. 'Tomorrow' in reported speech generally becomes:
a) The next day
b) Today
c) Yesterday

d) No change

16. Reported yes/no questions use:
a) That
b) If/whether
c) What
d) So

Answer Key

1-b 2-b 3-b 4-a 5-b 6-b 7-b 8-a 9-b 10-b 11-b 12-b 13-a 14-b 15-a 16-b

Part B — Cumulative, Weeks 1-4

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

7. The passive voice of "She writes a letter" is:
a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

11. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b 10-b 11-b 12-b

Week 5: Error Detection

Use this log to track your Technical English study sessions for Week 5. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Common Grammar Errors to Spot

Common Grammar Errors to Spot

Error detection questions present a sentence divided into parts and ask you to identify which part (if any) contains an error. Frequent error categories: subject-verb agreement mismatches, incorrect tense usage, wrong preposition, article errors (a/an/the), pronoun-antecedent mismatch, and faulty parallel structure.

Additional Practice Example: Identify and correct the error: 'Between you and I, this is a great idea.'

Solution: *Prepositions like 'between' take object pronouns, not subject pronouns — 'I' should be 'me': 'Between you and me, this is a great idea.'*

Day 1 Quiz

1. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

2. Identify the error: "He is senior than me."
a) He
b) is
c) senior than
d) me

3. Identify the error: 'She can able to solve it.'
a) She
b) can able
c) to solve
d) it

Answer Key

1-b 2-c 3-b

Day 2 — Common Grammar Errors to Spot

Common Grammar Errors to Spot

Strategy: read the whole sentence once for overall sense, then scan each segment specifically checking (1) does the verb match its subject in number, (2) is the tense consistent with the rest of the sentence, (3) are prepositions idiomatically correct (good AT something, not good ON something).

Additional Practice Example: Choose the correct word: 'The effect/affect of the new policy was significant.'

Solution: *'Effect' is normally a noun meaning result; 'affect' is normally a verb meaning to influence. Since a noun is needed here, the correct choice is 'effect.'*

Day 2 Quiz

1. Identify the error: "She don't like coffee."

a) She
b) don't
c) like
d) coffee

2. Identify the error: "I have visited Paris last year."

a) I
b) have visited
c) Paris
d) last year

3. Identify the error: 'She is taller than me is.'

a) She
b) is taller
c) than me is
d) No error

Answer Key

1-b 2-b 3-c

Day 3 — Common Grammar Errors to Spot

Common Grammar Errors to Spot

Worked Example: "Each of the students have submitted their assignment." — the error is in 'have'; since 'Each' is singular, it should be 'has'.

Additional Practice Example: Identify the figure of speech in: 'The stars danced in the night sky.'
Solution: *Giving human actions (dancing) to non-human things (stars) is personification.*

Day 3 Quiz

1. Identify the error: "He is good on mathematics."
a) He
b) is good
c) on
d) mathematics

2. Identify the error: "Neither of the two answers were correct."
a) Neither
b) of the two answers
c) were
d) correct

3. Identify the error: 'He don't never listen.'
a) He
b) don't never
c) listen
d) No error

Answer Key
1-c 2-c 3-b

Day 4 — Common Grammar Errors to Spot (Review)

Common Grammar Errors to Spot

Error detection questions present a sentence divided into parts and ask you to identify which part (if any) contains an error. Frequent error categories: subject-verb agreement mismatches, incorrect tense usage, wrong preposition, article errors (a/an/the), pronoun-antecedent mismatch, and faulty parallel structure.

Additional Practice Example: Correct the sentence: 'Neither the teacher nor the students was ready.'

Solution: *When 'neither...nor' joins a singular and plural subject, the verb agrees with the nearer subject — 'students' (plural), so the verb should be 'were': 'Neither the teacher nor the students were ready.'*

Day 4 Quiz

1. Identify the error: "One of the boys were late."
a) One
b) of the boys
c) were
d) late

2. Identify the error: "Everybody are happy today."
a) Everybody
b) are
c) happy
d) today

3. Identify the error: 'I am agree with you.'
a) I
b) am agree
c) with you
d) No error

Answer Key

1-c 2-b 3-b

Day 5 — Common Grammar Errors to Spot (Review)

Common Grammar Errors to Spot

Strategy: read the whole sentence once for overall sense, then scan each segment specifically checking (1) does the verb match its subject in number, (2) is the tense consistent with the rest of the sentence, (3) are prepositions idiomatically correct (good AT something, not good ON something).

Additional Practice Example: Convert to active voice: 'The novel was written by an unknown author in 1850.'

Solution: *Make the original agent the subject and the object of the passive sentence the new object: 'An unknown author wrote the novel in 1850.'*

Day 5 Quiz

1. Identify the error: "She is married with a doctor."

a) She
b) is married
c) with
d) a doctor

2. Identify the error: 'He is more taller than his brother.'

a) He
b) is more taller
c) than
d) his brother

Answer Key

1-c 2-b

Day 6 — Common Grammar Errors to Spot (Review)

Common Grammar Errors to Spot

Worked Example: "Each of the students have submitted their assignment." — the error is in 'have'; since 'Each' is singular, it should be 'has'.

Additional Practice Example: Identify the correctly punctuated sentence among: (a) Its raining, (b) It's raining.

Solution: *'It's' is the contraction of 'it is,' which fits the intended meaning here, so (b) 'It's raining' is correct; 'Its' (no apostrophe) is a possessive pronoun and would be wrong in this context.*

Day 6 Quiz

1. Identify the error: "The news are very shocking."
a) The
b) news
c) are
d) very shocking

2. Identify the error: 'I have less friends than you.'
a) I have
b) less friends
c) than
d) you

Answer Key

1-c 2-b

Week 5 Mock Test

Two short tests to close out Week 5: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 5 Only

1. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

2. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

3. Identify the error: "He is good on mathematics."
a) He
b) is good
c) on
d) mathematics

4. Identify the error: "One of the boys were late."
a) One
b) of the boys
c) were
d) late

5. Identify the error: "She is married with a doctor."
a) She
b) is married
c) with
d) a doctor

6. Identify the error: "The news are very shocking."
a) The
b) news
c) are
d) very shocking

7. Identify the error: "He is senior than me."
a) He
b) is
c) senior than

d) me

8. Identify the error: "I have visited Paris last year."
a) I
b) have visited
c) Paris
d) last year

9. Identify the error: "Neither of the two answers were correct."
a) Neither
b) of the two answers
c) were
d) correct

10. Identify the error: "Everybody are happy today."
a) Everybody
b) are
c) happy
d) today

11. Identify the error: 'He is more taller than his brother.'
a) He
b) is more taller
c) than
d) his brother

12. Identify the error: 'I have less friends than you.'
a) I have
b) less friends
c) than
d) you

13. Identify the error: 'She can able to solve it.'
a) She
b) can able
c) to solve
d) it

14. Identify the error: 'She is taller than me is.'
a) She
b) is taller
c) than me is
d) No error

15. Identify the error: 'He don't never listen.'
a) He
b) don't never
c) listen
d) No error

16. Identify the error: 'I am agree with you.'
a) I
b) am agree
c) with you
d) No error

Answer Key

1-b 2-b 3-c 4-c 5-c 6-c 7-c 8-b 9-c 10-b 11-b 12-b 13-b 14-c 15-b 16-b

Part B — Cumulative, Weeks 1-5

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

7. The passive voice of "She writes a letter" is:

a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

11. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

13. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

14. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

15. Identify the error: "He is good on mathematics."
a) He

b) is good
c) on
d) mathematics

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-c

Week 6: Reading Comprehension

Use this log to track your Technical English study sessions for Week 6. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Approaching Reading Comprehension

Approaching Reading Comprehension

Reading comprehension passages test whether you can extract the main idea, supporting details, tone, and inference from a short passage. Strategy: skim the passage first for the general topic, then read the questions before re-reading carefully — this tells you exactly what to look for, saving time.

Additional Practice Example: Find a synonym for 'meticulous' from context: 'She meticulously checked every line of code before submitting.'

Solution: *The context (checking every line carefully) supports 'careful and precise' as the meaning — synonyms include thorough, careful, precise, painstaking.*

Day 1 Quiz

1. A 'main idea' question in reading comprehension asks for:
a) A minor detail
b) The passage's central point
c) The author's name
d) A direct quotation only

2. The 'tone' of a passage refers to:
a) Its main idea
b) The author's attitude conveyed through word choice
c) The number of paragraphs
d) The passage's length

3. The best evidence for a detail question is:
a) Your outside knowledge
b) A specific sentence in the passage
c) Your opinion
d) The passage's title alone

Answer Key

1-b 2-b 3-b

Day 2 — Approaching Reading Comprehension

Approaching Reading Comprehension

Main idea questions ask 'what is this passage mostly about' — the answer is usually broader than any single sentence but narrower than the whole subject area. Detail questions ask about specific facts stated directly in the passage — the answer is usually a close paraphrase of one sentence. Inference questions ask what is implied but not directly stated — eliminate options that are either directly stated (too obvious) or unsupported by the text (too extreme).

Additional Practice Example: Convert direct to indirect: She asked, "Can you help me?"

Solution: *Yes/no questions in indirect speech use 'if' or 'whether,' drop the question mark, and remove inversion: 'She asked if I could help her.'*

Day 2 Quiz

1. An inference question asks about something that is:
a) Directly stated in the passage
b) Implied but not directly stated
c) Completely unrelated to the passage
d) Always false

2. A title question asks you to choose the option that:
a) Best summarizes the whole passage
b) Names a random detail
c) Repeats the first sentence
d) Uses the most complex vocabulary

3. A passage explaining steps in order is likely:
a) Narrative
b) Descriptive
c) Sequential/logical
d) Poetic

Answer Key

1-b 2-a 3-c

Day 3 — Approaching Reading Comprehension

Approaching Reading Comprehension

Tone/approach questions ask about the author's attitude or the passage's structure (descriptive, narrative, logical/argumentative, anatomical/technical) — look at word choice and sentence structure rather than content alone.

Additional Practice Example: Identify the error: 'He is one of the best player in the team.'
Solution: *Since 'one of the best' implies a superlative comparison among many, the noun should be plural: 'He is one of the best players in the team.'*

Day 3 Quiz

1. The best strategy before reading a passage in detail is to:
a) Read the questions first
b) Skip the passage entirely
c) Memorize every word
d) Only read the last paragraph

2. Skimming a passage before detailed reading helps you:
a) Memorize it word for word
b) Get the general topic and structure quickly
c) Avoid reading it at all
d) Answer without reading questions

3. The best way to answer a vocabulary-in-context question is to:
a) Ignore the passage entirely
b) Use surrounding context clues
c) Guess randomly
d) Look only at the word's length

Answer Key

1-a 2-b 3-b

Day 4 — Approaching Reading Comprehension (Review)

Approaching Reading Comprehension

Reading comprehension passages test whether you can extract the main idea, supporting details, tone, and inference from a short passage. Strategy: skim the passage first for the general topic, then read the questions before re-reading carefully — this tells you exactly what to look for, saving time.

Additional Practice Example: Choose the correct word: 'The book, along with the pen and notebook, ___ on the table.' (is/are)

Solution: *The subject is 'the book' (singular); phrases like 'along with...' don't add to the grammatical subject count, so the verb stays singular: 'is'.*

Day 4 Quiz

1. A passage that presents ideas in a step-by-step, cause-effect manner has a(n) ___ approach.
a) Narrative
b) Descriptive
c) Logical
d) Poetic

2. Detail questions differ from inference questions because detail answers are:
a) Never in the text
b) Directly stated in the text
c) Always opinions
d) Impossible to verify

3. An author's purpose might be to inform, persuade, or:
a) Confuse
b) Entertain
c) Nothing else
d) Delay

Answer Key

1-c 2-b 3-b

Day 5 — Approaching Reading Comprehension (Review)

Approaching Reading Comprehension

Main idea questions ask 'what is this passage mostly about' — the answer is usually broader than any single sentence but narrower than the whole subject area. Detail questions ask about specific facts stated directly in the passage — the answer is usually a close paraphrase of one sentence. Inference questions ask what is implied but not directly stated — eliminate options that are either directly stated (too obvious) or unsupported by the text (too extreme).

Additional Practice Example: Correct the sentence: 'She is one of those students who always does the homework.'

Solution: *The relative clause 'who...' refers to 'students' (plural), so the verb should agree with the plural: 'She is one of those students who always do the homework.'*

Day 5 Quiz

1. The correct answer to a detail question is usually:
a) A close paraphrase of a specific sentence
b) An opinion not in the text
c) A guess
d) Always the first option

2. A passage's structure that presents events in time order is:
a) Logical
b) Narrative
c) Anatomical
d) Poetic

Answer Key

1-a 2-b

Day 6 — Approaching Reading Comprehension (Review)

Approaching Reading Comprehension

Tone/approach questions ask about the author's attitude or the passage's structure (descriptive, narrative, logical/argumentative, anatomical/technical) — look at word choice and sentence structure rather than content alone.

Additional Practice Example: Identify the tone of a passage that uses phrases like 'unfortunately' and 'sadly' throughout.
Solution: *Repeated use of negative-connotation adverbs like 'unfortunately' and 'sadly' signals a pessimistic or regretful tone.*

Day 6 Quiz

1. If an inference option is too extreme or unsupported by the text, you should:
a) Choose it anyway
b) Eliminate it
c) Assume it's correct if it sounds smart
d) Reread only that option

2. An 'inference' should never be:
a) Supported by the passage
b) Directly contradicted by the passage
c) Reasonable
d) Careful

Answer Key

1-b 2-b

Week 6 Mock Test

Two short tests to close out Week 6: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 6 Only

1. A 'main idea' question in reading comprehension asks for:
a) A minor detail
b) The passage's central point
c) The author's name
d) A direct quotation only

2. An inference question asks about something that is:
a) Directly stated in the passage
b) Implied but not directly stated
c) Completely unrelated to the passage
d) Always false

3. The best strategy before reading a passage in detail is to:
a) Read the questions first
b) Skip the passage entirely
c) Memorize every word
d) Only read the last paragraph

4. A passage that presents ideas in a step-by-step, cause-effect manner has a(n) ___ approach.
a) Narrative
b) Descriptive
c) Logical
d) Poetic

5. The correct answer to a detail question is usually:
a) A close paraphrase of a specific sentence
b) An opinion not in the text
c) A guess
d) Always the first option

6. If an inference option is too extreme or unsupported by the text, you should:
a) Choose it anyway
b) Eliminate it
c) Assume it's correct if it sounds smart
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7. The 'tone' of a passage refers to:
a) Its main idea
b) The author's attitude conveyed through word choice
c) The number of paragraphs

d) The passage's length

8. A title question asks you to choose the option that:
a) Best summarizes the whole passage
b) Names a random detail
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13. The best evidence for a detail question is:
a) Your outside knowledge
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a) Ignore the passage entirely
b) Use surrounding context clues
c) Guess randomly
d) Look only at the word's length

16. An author's purpose might be to inform, persuade, or:
a) Confuse
b) Entertain
c) Nothing else
d) Delay

Answer Key

1-b 2-b 3-a 4-c 5-a 6-b 7-b 8-a 9-b 10-b 11-b 12-b 13-b 14-c 15-b 16-b

Part B — Cumulative, Weeks 1-6

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

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a) A letter is written by her
b) A letter was written by her
c) A letter writes her
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8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
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c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
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d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
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b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

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a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

13. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

14. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

15. Identify the error: "He is good on mathematics."
a) He

b) is good
c) on
d) mathematics

16. A 'main idea' question in reading comprehension asks for:
a) A minor detail
b) The passage's central point
c) The author's name
d) A direct quotation only

17. An inference question asks about something that is:
a) Directly stated in the passage
b) Implied but not directly stated
c) Completely unrelated to the passage
d) Always false

18. The best strategy before reading a passage in detail is to:
a) Read the questions first
b) Skip the passage entirely
c) Memorize every word
d) Only read the last paragraph

Answer Key

1-b	*2-c*	*3-c*	*4-b*	*5-b*	*6-c*	*7-a*	*8-b*	*9-b*	*10-b*	*11-b*	*12-b*	*13-b*	*14-b*	*15-c*	*16-b*	*17-b*	*18-a*

Week 7: Synonyms & Antonyms

Use this log to track your Technical English study sessions for Week 7. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Building Synonym/Antonym Fluency

Building Synonym/Antonym Fluency

Synonym/antonym questions test vocabulary breadth directly. The fastest way to prepare is grouping words by 'families' of meaning (e.g. words meaning 'careful': meticulous, cautious, prudent, vigilant) rather than memorizing isolated word-definition pairs.

Additional Practice Example: Choose the correct form: 'If I ___ rich, I would travel the world.' (was/were)
Solution: *This is a hypothetical/subjunctive condition, which conventionally uses 'were' regardless of subject: 'If I were rich...'*

Day 1 Quiz

1. Antonym of "Benevolent":
a) Kind
b) Malevolent
c) Generous
d) Charitable

2. The prefix 'mal-' generally indicates:
a) Good
b) Bad
c) Neutral
d) Large

3. Antonym of "Reluctant":
a) Hesitant
b) Willing
c) Unwilling
d) Doubtful

Answer Key
1-b 2-b 3-b

Day 2 — Building Synonym/Antonym Fluency

Building Synonym/Antonym Fluency

Useful pairs to know: Abundant ↔ Scarce; Benevolent ↔ Malevolent; Meticulous ↔ Careless; Coherent ↔ Incoherent; Feasible ↔ Impractical; Robust ↔ Fragile; Transparent ↔ Opaque; Voluntary ↔ Compulsory; Genuine ↔ Fake; Optimistic ↔ Pessimistic.

Additional Practice Example: Identify the error: 'The number of students are increasing every year.'

Solution: *'The number of' is treated as singular (it's the number, not the students, that is the subject), so the verb should be 'is': 'The number of students is increasing every year.'*

Day 2 Quiz

1. Synonym of "Abundant":
a) Scarce
b) Plentiful
c) Rare
d) Limited

2. Antonym of "Voluntary":
a) Optional
b) Compulsory
c) Willing
d) Free

3. Antonym of "Ample":
a) Plentiful
b) Insufficient
c) Large
d) Generous

Answer Key

1-b 2-b 3-b

Day 3 — Building Synonym/Antonym Fluency

Building Synonym/Antonym Fluency

For unfamiliar words in an exam, use root/prefix clues: 'bene-' (good, as in benevolent, benefit), 'mal-' (bad, as in malevolent, malfunction), 'in-/im-' (often negation, as in incoherent, impractical).

Additional Practice Example: Convert to passive: 'Someone stole my bicycle last night.'
Solution: *'Someone' becomes the omittable agent, and 'my bicycle' becomes the subject: 'My bicycle was stolen last night.'*

Day 3 Quiz

1. Antonym of "Meticulous":
a) Careful
b) Careless
c) Precise
d) Detailed

2. Synonym of "Genuine":
a) Fake
b) Authentic
c) Doubtful
d) Artificial

3. Synonym of "Tedious":
a) Exciting
b) Boring/monotonous
c) Quick
d) Colorful

Answer Key

1-b 2-b 3-b

Day 4 — Building Synonym/Antonym Fluency (Review)

Building Synonym/Antonym Fluency

Synonym/antonym questions test vocabulary breadth directly. The fastest way to prepare is grouping words by 'families' of meaning (e.g. words meaning 'careful': meticulous, cautious, prudent, vigilant) rather than memorizing isolated word-definition pairs.

Additional Practice Example: Identify the error: 'I would rather to go home now.'
Solution: *'Would rather' is followed by a bare infinitive (without 'to'): 'I would rather go home now.'*

Day 4 Quiz

1. Synonym of "Coherent":
a) Confusing
b) Logical/consistent
c) Random
d) Silent

2. Antonym of "Optimistic":
a) Hopeful
b) Pessimistic
c) Confident
d) Cheerful

3. Antonym of "Concise":
a) Brief
b) Wordy
c) Clear
d) Short

Answer Key

1-b 2-b 3-b

Day 5 — Building Synonym/Antonym Fluency (Review)

Building Synonym/Antonym Fluency

Useful pairs to know: Abundant ↔ Scarce; Benevolent ↔ Malevolent; Meticulous ↔ Careless; Coherent ↔ Incoherent; Feasible ↔ Impractical; Robust ↔ Fragile; Transparent ↔ Opaque; Voluntary ↔ Compulsory; Genuine ↔ Fake; Optimistic ↔ Pessimistic.

Additional Practice Example: Choose the correct word: 'The effect of the medicine was ___ (immediate/immediately).'
Solution: *Since a noun ('effect') needs an adjective to describe it, 'immediate' is correct: 'The effect...was immediate.'*

Day 5 Quiz

1. Antonym of "Transparent":
a) Clear
b) Opaque
c) Visible
d) Honest

2. Antonym of "Frugal":
a) Thrifty
b) Extravagant
c) Careful
d) Modest

Answer Key

1-b 2-b

Day 6 — Building Synonym/Antonym Fluency (Review)

Building Synonym/Antonym Fluency

For unfamiliar words in an exam, use root/prefix clues: 'bene-' (good, as in benevolent, benefit), 'mal-' (bad, as in malevolent, malfunction), 'in-/im-' (often negation, as in incoherent, impractical).

Additional Practice Example: Convert to passive: 'They are painting the house.'
Solution: *'The house is being painted (by them).'*

Day 6 Quiz

1. Synonym of "Robust":
a) Fragile
b) Weak
c) Strong/sturdy
d) Small

2. Synonym of "Diligent":
a) Lazy
b) Hardworking
c) Careless
d) Slow

Answer Key

1-c 2-b

Week 7 Mock Test

Two short tests to close out Week 7: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 7 Only

1. Antonym of "Benevolent":
a) Kind
b) Malevolent
c) Generous
d) Charitable

2. Synonym of "Abundant":
a) Scarce
b) Plentiful
c) Rare
d) Limited

3. Antonym of "Meticulous":
a) Careful
b) Careless
c) Precise
d) Detailed

4. Synonym of "Coherent":
a) Confusing
b) Logical/consistent
c) Random
d) Silent

5. Antonym of "Transparent":
a) Clear
b) Opaque
c) Visible
d) Honest

6. Synonym of "Robust":
a) Fragile
b) Weak
c) Strong/sturdy
d) Small

7. The prefix 'mal-' generally indicates:
a) Good
b) Bad
c) Neutral

d) Large

8. Antonym of "Voluntary":
a) Optional
b) Compulsory
c) Willing
d) Free

9. Synonym of "Genuine":
a) Fake
b) Authentic
c) Doubtful
d) Artificial

10. Antonym of "Optimistic":
a) Hopeful
b) Pessimistic
c) Confident
d) Cheerful

11. Antonym of "Frugal":
a) Thrifty
b) Extravagant
c) Careful
d) Modest

12. Synonym of "Diligent":
a) Lazy
b) Hardworking
c) Careless
d) Slow

13. Antonym of "Reluctant":
a) Hesitant
b) Willing
c) Unwilling
d) Doubtful

14. Antonym of "Ample":
a) Plentiful
b) Insufficient
c) Large
d) Generous

15. Synonym of "Tedious":
a) Exciting
b) Boring/monotonous
c) Quick
d) Colorful

16. Antonym of "Concise":
a) Brief
b) Wordy
c) Clear
d) Short

Answer Key

1-b 2-b 3-b 4-b 5-b 6-c 7-b 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-b 16-b

Part B — Cumulative, Weeks 1-7

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

7. The passive voice of "She writes a letter" is:

a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

11. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

13. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

14. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

15. Identify the error: "He is good on mathematics."
a) He

b) is good
c) on
d) mathematics

16. A 'main idea' question in reading comprehension asks for:
a) A minor detail
b) The passage's central point
c) The author's name
d) A direct quotation only

17. An inference question asks about something that is:
a) Directly stated in the passage
b) Implied but not directly stated
c) Completely unrelated to the passage
d) Always false

18. The best strategy before reading a passage in detail is to:
a) Read the questions first
b) Skip the passage entirely
c) Memorize every word
d) Only read the last paragraph

19. Antonym of "Benevolent":
a) Kind
b) Malevolent
c) Generous
d) Charitable

20. Synonym of "Abundant":
a) Scarce
b) Plentiful
c) Rare
d) Limited

21. Antonym of "Meticulous":
a) Careful
b) Careless
c) Precise
d) Detailed

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b

Week 8: Grammar Revision — Consolidated

Use this log to track your Technical English study sessions for Week 8. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Consolidated Grammar Review

Consolidated Grammar Review

This week, revisit tenses, voice, and narration together, since real exam questions often blend them (e.g. a passive-voice sentence in reported speech). Re-do the worked examples from Weeks 2-4 from memory before checking your answers.

Additional Practice Example: Identify the error: 'He is the most cleverest boy in the class.'
Solution: *Using both 'most' and the superlative '-est' together is redundant: it should be either 'the cleverest' or 'the most clever'.*

Day 1 Quiz

1. "The letter ___ by her yesterday." (correct passive, past simple)
a) is written
b) was written
c) has been written
d) will be written

2. "I wish I ___ taller." (subjunctive)
a) am
b) was
c) were
d) be

3. Choose the correct sentence:
a) Everyone have their own opinion
b) Everyone has their own opinion
c) Everyone having own opinion
d) Everyone has they own opinion

Answer Key

1-b 2-c 3-b

Day 2 — Consolidated Grammar Review

Consolidated Grammar Review

Quick-reference checklist to run through before answering any grammar item: (1) Does the verb agree with its true subject in number? (2) Is the tense consistent with time markers in the sentence (yesterday, next year, since 2020)? (3) Is the correct preposition used idiomatically? (4) If passive, is 'be + past participle' correctly formed for that tense?

Additional Practice Example: Choose the correct preposition: 'She succeeded ___ passing the exam.'

Solution: *'Succeed in' is the correct idiomatic pairing: 'She succeeded in passing the exam.'*

Day 2 Quiz

1. "He said that he ___ finished the work." (past perfect, from 'I have finished')
a) has
b) have
c) had
d) was

2. "Neither the teacher nor the students ___ present."
a) is
b) was
c) were
d) has been

3. 'If she ___ harder, she would pass.' (hypothetical)
a) studies
b) studied
c) will study
d) has studied

Answer Key

1-c 2-c 3-b

Day 3 — Consolidated Grammar Review (Review)

Consolidated Grammar Review

This week, revisit tenses, voice, and narration together, since real exam questions often blend them (e.g. a passive-voice sentence in reported speech). Re-do the worked examples from Weeks 2-4 from memory before checking your answers.

Additional Practice Example: Convert to passive voice: 'The committee will announce the results tomorrow.'

Solution: *Identify the object (the results) as the new subject, use 'will be' + past participle, and optionally add the agent: 'The results will be announced by the committee tomorrow.'*

Day 3 Quiz

1. Choose the grammatically correct sentence:
a) She don't like tea
b) She doesn't likes tea
c) She doesn't like tea
d) She not like tea

2. Choose the correct article usage: "She is ___ honest person."
a) a
b) an
c) the
d) no article

3. Correct preposition: 'He is capable ___ solving it.'
a) of
b) to
c) for
d) with

Answer Key

1-c 2-b 3-a

Day 4 — Consolidated Grammar Review (Review)

Consolidated Grammar Review

Quick-reference checklist to run through before answering any grammar item: (1) Does the verb agree with its true subject in number? (2) Is the tense consistent with time markers in the sentence (yesterday, next year, since 2020)? (3) Is the correct preposition used idiomatically? (4) If passive, is 'be + past participle' correctly formed for that tense?

Additional Practice Example: Convert to indirect speech: He said, "I have finished my homework."

Solution: *The reporting verb 'said' is past tense, so present perfect ('have finished') shifts to past perfect: 'He said that he had finished his homework.'*

Day 4 Quiz

1. "By the time we arrived, the movie ___ started."
a) has
b) have
c) had
d) having

2. "He asked me if I ___ready." (from direct: "Are you ready?")
a) am
b) was
c) were
d) will be

3. Choose the grammatically correct option:
a) He don't care
b) He doesn't cares
c) He doesn't care
d) He not care

Answer Key

1-c 2-b 3-c

Day 5 — Consolidated Grammar Review (Review)

Consolidated Grammar Review

This week, revisit tenses, voice, and narration together, since real exam questions often blend them (e.g. a passive-voice sentence in reported speech). Re-do the worked examples from Weeks 2-4 from memory before checking your answers.

Additional Practice Example: Identify and correct the error: 'Between you and I, this is a great idea.'

Solution: *Prepositions like 'between' take object pronouns, not subject pronouns — 'I' should be 'me': 'Between you and me, this is a great idea.'*

Day 5 Quiz

1. The correct preposition: "He is interested ___ music."

a) on
b) in
c) at
d) of

2. 'She ___ (finish) the work before I arrived.' (past perfect)

a) finishes
b) finished
c) had finished
d) has finished

Answer Key

1-b 2-c

Day 6 — Consolidated Grammar Review (Review)

Consolidated Grammar Review

Quick-reference checklist to run through before answering any grammar item: (1) Does the verb agree with its true subject in number? (2) Is the tense consistent with time markers in the sentence (yesterday, next year, since 2020)? (3) Is the correct preposition used idiomatically? (4) If passive, is 'be + past participle' correctly formed for that tense?

Additional Practice Example: Choose the correct word: 'The effect/affect of the new policy was significant.'

Solution: *'Effect' is normally a noun meaning result; 'affect' is normally a verb meaning to influence. Since a noun is needed here, the correct choice is 'effect.'*

Day 6 Quiz

1. Passive of "They will complete the project."

a) The project will be completed by them
b) The project completed by them
c) The project is completing by them
d) The project completes by them

2. Correct preposition: 'He apologized ___ his mistake.'

a) for
b) to
c) of
d) about

Answer Key

1-a 2-a

Week 8 Mock Test

Two short tests to close out Week 8: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 8 Only

1. "The letter ___ by her yesterday." (correct passive, past simple)
a) is written
b) was written
c) has been written
d) will be written

2. "He said that he ___ finished the work." (past perfect, from 'I have finished')
a) has
b) have
c) had
d) was

3. Choose the grammatically correct sentence:
a) She don't like tea
b) She doesn't likes tea
c) She doesn't like tea
d) She not like tea

4. "By the time we arrived, the movie ___ started."
a) has
b) have
c) had
d) having

5. The correct preposition: "He is interested ___ music."
a) on
b) in
c) at
d) of

6. Passive of "They will complete the project."
a) The project will be completed by them
b) The project completed by them
c) The project is completing by them
d) The project completes by them

7. "I wish I ___ taller." (subjunctive)
a) am
b) was
c) were

d) be

8. "Neither the teacher nor the students ___ present."
a) is
b) was
c) were
d) has been

9. Choose the correct article usage: "She is ___ honest person."
a) a
b) an
c) the
d) no article

10. "He asked me if I ___ready." (from direct: "Are you ready?")
a) am
b) was
c) were
d) will be

11. 'She ___ (finish) the work before I arrived.' (past perfect)
a) finishes
b) finished
c) had finished
d) has finished

12. Correct preposition: 'He apologized ___ his mistake.'
a) for
b) to
c) of
d) about

13. Choose the correct sentence:
a) Everyone have their own opinion
b) Everyone has their own opinion
c) Everyone having own opinion
d) Everyone has they own opinion

14. 'If she ___ harder, she would pass.' (hypothetical)
a) studies
b) studied
c) will study
d) has studied

15. Correct preposition: 'He is capable ___ solving it.'
a) of
b) to
c) for
d) with

16. Choose the grammatically correct option:
a) He don't care
b) He doesn't cares
c) He doesn't care
d) He not care

Answer Key

1-b 2-c 3-c 4-c 5-b 6-a 7-c 8-c 9-b 10-b 11-c 12-a 13-b 14-b 15-a 16-c

Part B — Cumulative, Weeks 1-8

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

7. The passive voice of "She writes a letter" is:

a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

11. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

13. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

14. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

15. Identify the error: "He is good on mathematics."
a) He

b) is good
c) on
d) mathematics

16. A 'main idea' question in reading comprehension asks for:
a) A minor detail
b) The passage's central point
c) The author's name
d) A direct quotation only

17. An inference question asks about something that is:
a) Directly stated in the passage
b) Implied but not directly stated
c) Completely unrelated to the passage
d) Always false

18. The best strategy before reading a passage in detail is to:
a) Read the questions first
b) Skip the passage entirely
c) Memorize every word
d) Only read the last paragraph

19. Antonym of "Benevolent":
a) Kind
b) Malevolent
c) Generous
d) Charitable

20. Synonym of "Abundant":
a) Scarce
b) Plentiful
c) Rare
d) Limited

21. Antonym of "Meticulous":
a) Careful
b) Careless
c) Precise
d) Detailed

22. "The letter ___ by her yesterday." (correct passive, past simple)
a) is written
b) was written
c) has been written
d) will be written

23. "He said that he ___ finished the work." (past perfect, from 'I have finished')
a) has
b) have

c) had
d) was

24. Choose the grammatically correct sentence:
a) She don't like tea
b) She doesn't likes tea
c) She doesn't like tea
d) She not like tea

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b 22-b 23-c 24-c

Week 9: Vocabulary Revision — Consolidated Word List

Use this log to track your Technical English study sessions for Week 9. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — High-Yield Word List

High-Yield Word List

Review this consolidated list daily this week, testing yourself both ways (word→meaning and meaning→word): Arbitrary (based on random choice, not reason), Coherent (logical and consistent), Feasible (achievable), Meticulous (very careful and precise), Plausible (believable), Redundant (no longer needed, superfluous), Robust (strong, resilient), Substantial (large in amount/importance), Ubiquitous (present everywhere), Inherent (existing as a natural/permanent part of something), Adequate (sufficient), Comprehensive (complete, covering everything), Ambiguous (open to more than one interpretation), Pragmatic (dealing with things practically), Concise (giving information clearly in few words).

Additional Practice Example: Identify the figure of speech in: 'The stars danced in the night sky.'

Solution: *Giving human actions (dancing) to non-human things (stars) is personification.*

Day 1 Quiz

1. "Arbitrary" most nearly means:
a) Carefully reasoned
b) Based on random choice, not reason
c) Extremely detailed
d) Permanent

2. "Inherent" most nearly means:
a) External
b) Existing as a natural, permanent part of something
c) Temporary
d) Borrowed

3. "Reluctant" most nearly means:
a) Eager
b) Unwilling or hesitant
c) Confident
d) Fast

Answer Key

1-b 2-b 3-b

Day 2 — High-Yield Word List

High-Yield Word List

Practice using each word in an original sentence rather than only reading the definition — active use cements retention far better than passive recognition.

Additional Practice Example: Correct the sentence: 'Neither the teacher nor the students was ready.'

Solution: *When 'neither...nor' joins a singular and plural subject, the verb agrees with the nearer subject — 'students' (plural), so the verb should be 'were': 'Neither the teacher nor the students were ready.'*

Day 2 Quiz

1. "Redundant" most nearly means:
a) Essential
b) Superfluous/unnecessary
c) Complicated
d) Rare

2. "Comprehensive" most nearly means:
a) Partial
b) Complete, covering everything
c) Confusing
d) Brief

3. "Ample" most nearly means:
a) Insufficient
b) Plentiful/enough
c) Small
d) Rare

Answer Key

1-b 2-b 3-b

Day 3 — High-Yield Word List (Review)

High-Yield Word List

Review this consolidated list daily this week, testing yourself both ways (word→meaning and meaning→word): Arbitrary (based on random choice, not reason), Coherent (logical and consistent), Feasible (achievable), Meticulous (very careful and precise), Plausible (believable), Redundant (no longer needed, superfluous), Robust (strong, resilient), Substantial (large in amount/importance), Ubiquitous (present everywhere), Inherent (existing as a natural/permanent part of something), Adequate (sufficient), Comprehensive (complete, covering everything), Ambiguous (open to more than one interpretation), Pragmatic (dealing with things practically), Concise (giving information clearly in few words).

Additional Practice Example: Convert to active voice: 'The novel was written by an unknown author in 1850.'

Solution: *Make the original agent the subject and the object of the passive sentence the new object: 'An unknown author wrote the novel in 1850.'*

Day 3 Quiz

1. "Plausible" most nearly means:
a) Impossible
b) Believable
c) Confusing
d) Forbidden

2. "Adequate" most nearly means:
a) Insufficient
b) Sufficient
c) Excessive
d) Irrelevant

3. "Tedious" most nearly means:
a) Exciting
b) Boring and slow
c) Fast
d) Colorful

Answer Key

1-b 2-b 3-b

Day 4 — High-Yield Word List (Review)

High-Yield Word List

Practice using each word in an original sentence rather than only reading the definition — active use cements retention far better than passive recognition.

Additional Practice Example: Identify the correctly punctuated sentence among: (a) Its raining, (b) It's raining.

Solution: *'It's' is the contraction of 'it is,' which fits the intended meaning here, so (b) 'It's raining' is correct; 'Its' (no apostrophe) is a possessive pronoun and would be wrong in this context.*

Day 4 Quiz

1. "Ambiguous" most nearly means:
a) Perfectly clear
b) Open to more than one interpretation
c) Extremely long
d) Very short

2. "Substantial" most nearly means:
a) Trivial
b) Large in amount or importance
c) Uncertain
d) Fake

3. "Verbose" most nearly means:
a) Brief
b) Using excessive words
c) Silent
d) Clear

Answer Key

1-b 2-b 3-b

Day 5 — High-Yield Word List (Review)

High-Yield Word List

Review this consolidated list daily this week, testing yourself both ways (word→meaning and meaning→word): Arbitrary (based on random choice, not reason), Coherent (logical and consistent), Feasible (achievable), Meticulous (very careful and precise), Plausible (believable), Redundant (no longer needed, superfluous), Robust (strong, resilient), Substantial (large in amount/importance), Ubiquitous (present everywhere), Inherent (existing as a natural/permanent part of something), Adequate (sufficient), Comprehensive (complete, covering everything), Ambiguous (open to more than one interpretation), Pragmatic (dealing with things practically), Concise (giving information clearly in few words).

Additional Practice Example: Find a synonym for 'meticulous' from context: 'She meticulously checked every line of code before submitting.'

Solution: *The context (checking every line carefully) supports 'careful and precise' as the meaning — synonyms include thorough, careful, precise, painstaking.*

Day 5 Quiz

1. "Pragmatic" most nearly means:
a) Idealistic
b) Dealing with things practically
c) Emotional
d) Theoretical only

2. "Candid" most nearly means:
a) Secretive
b) Frank and honest
c) Confusing
d) Aggressive

Answer Key

1-b 2-b

Day 6 — High-Yield Word List (Review)

High-Yield Word List

Practice using each word in an original sentence rather than only reading the definition — active use cements retention far better than passive recognition.

Additional Practice Example: Convert direct to indirect: She asked, "Can you help me?"
Solution: *Yes/no questions in indirect speech use 'if' or 'whether,' drop the question mark, and remove inversion: 'She asked if I could help her.'*

Day 6 Quiz

1. "Concise" most nearly means:
a) Wordy
b) Brief and clear
c) Vague
d) Repetitive

2. "Diligent" most nearly means:
a) Careless
b) Hardworking and careful
c) Slow
d) Forgetful

Answer Key

1-b 2-b

Week 9 Mock Test

Two short tests to close out Week 9: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 9 Only

1. "Arbitrary" most nearly means:
a) Carefully reasoned
b) Based on random choice, not reason
c) Extremely detailed
d) Permanent

2. "Redundant" most nearly means:
a) Essential
b) Superfluous/unnecessary
c) Complicated
d) Rare

3. "Plausible" most nearly means:
a) Impossible
b) Believable
c) Confusing
d) Forbidden

4. "Ambiguous" most nearly means:
a) Perfectly clear
b) Open to more than one interpretation
c) Extremely long
d) Very short

5. "Pragmatic" most nearly means:
a) Idealistic
b) Dealing with things practically
c) Emotional
d) Theoretical only

6. "Concise" most nearly means:
a) Wordy
b) Brief and clear
c) Vague
d) Repetitive

7. "Inherent" most nearly means:
a) External
b) Existing as a natural, permanent part of something
c) Temporary

d) Borrowed

8. "Comprehensive" most nearly means:
a) Partial
b) Complete, covering everything
c) Confusing
d) Brief

9. "Adequate" most nearly means:
a) Insufficient
b) Sufficient
c) Excessive
d) Irrelevant

10. "Substantial" most nearly means:
a) Trivial
b) Large in amount or importance
c) Uncertain
d) Fake

11. "Candid" most nearly means:
a) Secretive
b) Frank and honest
c) Confusing
d) Aggressive

12. "Diligent" most nearly means:
a) Careless
b) Hardworking and careful
c) Slow
d) Forgetful

13. "Reluctant" most nearly means:
a) Eager
b) Unwilling or hesitant
c) Confident
d) Fast

14. "Ample" most nearly means:
a) Insufficient
b) Plentiful/enough
c) Small
d) Rare

15. "Tedious" most nearly means:
a) Exciting
b) Boring and slow
c) Fast
d) Colorful

16. "Verbose" most nearly means:
a) Brief
b) Using excessive words
c) Silent
d) Clear

Answer Key

1-b	*2-b*	*3-b*	*4-b*	*5-b*	*6-b*	*7-b*	*8-b*	*9-b*	*10-b*	*11-b*	*12-b*	*13-b*	*14-b*	*15-b*	*16-b*

Part B — Cumulative, Weeks 1-9

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
c) having
d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
a) knows
b) have known
c) know
d) were knowing

7. The passive voice of "She writes a letter" is:

a) A letter is written by her
b) A letter was written by her
c) A letter writes her
d) She is written a letter

8. The passive voice of "The chef cooked the meal" is:
a) The meal cooks the chef
b) The meal was cooked by the chef
c) The meal is cooked by the chef
d) The chef is cooked by the meal

9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
c) He said he is tired now
d) He tells that he was tired

11. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

13. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

14. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

15. Identify the error: "He is good on mathematics."
a) He

b) is good
c) on
d) mathematics

16. A 'main idea' question in reading comprehension asks for:
a) A minor detail
b) The passage's central point
c) The author's name
d) A direct quotation only

17. An inference question asks about something that is:
a) Directly stated in the passage
b) Implied but not directly stated
c) Completely unrelated to the passage
d) Always false

18. The best strategy before reading a passage in detail is to:
a) Read the questions first
b) Skip the passage entirely
c) Memorize every word
d) Only read the last paragraph

19. Antonym of "Benevolent":
a) Kind
b) Malevolent
c) Generous
d) Charitable

20. Synonym of "Abundant":
a) Scarce
b) Plentiful
c) Rare
d) Limited

21. Antonym of "Meticulous":
a) Careful
b) Careless
c) Precise
d) Detailed

22. "The letter ___ by her yesterday." (correct passive, past simple)
a) is written
b) was written
c) has been written
d) will be written

23. "He said that he ___ finished the work." (past perfect, from 'I have finished')
a) has
b) have

c) had
d) was

24. Choose the grammatically correct sentence:
a) She don't like tea
b) She doesn't likes tea
c) She doesn't like tea
d) She not like tea

25. "Arbitrary" most nearly means:
a) Carefully reasoned
b) Based on random choice, not reason
c) Extremely detailed
d) Permanent

26. "Redundant" most nearly means:
a) Essential
b) Superfluous/unnecessary
c) Complicated
d) Rare

27. "Plausible" most nearly means:
a) Impossible
b) Believable
c) Confusing
d) Forbidden

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b 22-b 23-c 24-c 25-b 26-b 27-b

Week 10: Full English Practice

Use this log to track your Technical English study sessions for Week 10. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Mixed Practice

Mixed Practice

This week, combine every English sub-skill in mixed order — grammar, vocabulary, and a short passage — exactly as they'll appear interleaved in the real 10-question Technical English section. Time yourself: aim to answer all 10 in under 6 minutes, leaving buffer time for the rest of the exam.

Additional Practice Example: Identify the error: 'He is one of the best player in the team.'
Solution: *Since 'one of the best' implies a superlative comparison among many, the noun should be plural: 'He is one of the best players in the team.'*

Day 1 Quiz

1. Choose the correctly punctuated sentence:
a) Its a nice day
b) It's a nice day
c) Its' a nice day
d) Its a, nice day

2. Passive form of "The scientist discovered a new species":
a) A new species discovered the scientist
b) A new species was discovered by the scientist
c) A new species is discovering the scientist
d) A new species discovers the scientist

3. Identify the correctly spelled word:
a) Occassion
b) Occasion
c) Ocasion
d) Occaision

Answer Key

1-b 2-b 3-b

Day 2 — Mixed Practice (Review)

Mixed Practice

This week, combine every English sub-skill in mixed order — grammar, vocabulary, and a short passage — exactly as they'll appear interleaved in the real 10-question Technical English section. Time yourself: aim to answer all 10 in under 6 minutes, leaving buffer time for the rest of the exam.

Additional Practice Example: Choose the correct word: 'The book, along with the pen and notebook, ___ on the table.' (is/are)

Solution: *The subject is 'the book' (singular); phrases like 'along with...' don't add to the grammatical subject count, so the verb stays singular: 'is'.*

Day 2 Quiz

1. "We are trying to separate the wheat from the chaff" uses language in a ___ sense.
a) Literal
b) Figurative
c) Poetic
d) Technical

2. Antonym of "Genuine":
a) Authentic
b) Fake
c) Sincere
d) True

3. Choose the sentence free of errors:
a) He is one of the boy who plays well
b) He is one of the boys who play well
c) He is one of the boys who plays well
d) He one of the boys play well

Answer Key

1-b 2-b 3-b

Day 3 — Mixed Practice (Review)

Mixed Practice

This week, combine every English sub-skill in mixed order — grammar, vocabulary, and a short passage — exactly as they'll appear interleaved in the real 10-question Technical English section. Time yourself: aim to answer all 10 in under 6 minutes, leaving buffer time for the rest of the exam.

Additional Practice Example: Correct the sentence: 'She is one of those students who always does the homework.'

Solution: *The relative clause 'who...' refers to 'students' (plural), so the verb should agree with the plural: 'She is one of those students who always do the homework.'*

Day 3 Quiz

1. Choose the correct sentence:
a) He don't know the answer
b) He doesn't know the answer
c) He not knows the answer
d) He doesn't knows the answer

2. The correct preposition: "She is afraid ___ spiders."
a) from
b) of
c) with
d) on

3. Correct indirect question: 'Why are you late?' he asked.
a) He asked why I was late
b) He asked why was I late
c) He asked that why I was late
d) He asked why am I late

Answer Key

1-b 2-b 3-a

Day 4 — Mixed Practice (Review)

Mixed Practice

This week, combine every English sub-skill in mixed order — grammar, vocabulary, and a short passage — exactly as they'll appear interleaved in the real 10-question Technical English section. Time yourself: aim to answer all 10 in under 6 minutes, leaving buffer time for the rest of the exam.

Additional Practice Example: Identify the tone of a passage that uses phrases like 'unfortunately' and 'sadly' throughout.
Solution: *Repeated use of negative-connotation adverbs like 'unfortunately' and 'sadly' signals a pessimistic or regretful tone.*

Day 4 Quiz

1. Synonym of "Meticulous":
a) Careless
b) Careful and precise
c) Fast
d) Lazy

2. A passage's 'main idea' is best described as its:
a) Least important detail
b) Central point
c) Longest sentence
d) Title only

3. Identify the correctly spelled word:
a) Definately
b) Definitely
c) Definitly
d) Difinitely

Answer Key

1-b 2-b 3-b

Day 5 — Mixed Practice (Review)

Mixed Practice

This week, combine every English sub-skill in mixed order — grammar, vocabulary, and a short passage — exactly as they'll appear interleaved in the real 10-question Technical English section. Time yourself: aim to answer all 10 in under 6 minutes, leaving buffer time for the rest of the exam.

Additional Practice Example: Choose the correct form: 'If I ___ rich, I would travel the world.' (was/were)

Solution: *This is a hypothetical/subjunctive condition, which conventionally uses 'were' regardless of subject: 'If I were rich...'*

Day 5 Quiz

1. "She said she ___ come the next day." (reported from "I will come tomorrow")
a) will
b) would
c) can
d) shall

2. Choose the sentence free of errors:
a) Neither of them are ready
b) Neither of them is ready
c) Neither of they is ready
d) Neither of them being ready

Answer Key

1-b 2-b

Day 6 — Mixed Practice (Review)

Mixed Practice

This week, combine every English sub-skill in mixed order — grammar, vocabulary, and a short passage — exactly as they'll appear interleaved in the real 10-question Technical English section. Time yourself: aim to answer all 10 in under 6 minutes, leaving buffer time for the rest of the exam.

Additional Practice Example: Identify the error: 'The number of students are increasing every year.'
Solution: *'The number of' is treated as singular (it's the number, not the students, that is the subject), so the verb should be 'is': 'The number of students is increasing every year.'*

Day 6 Quiz

1. Choose the grammatically correct sentence:
a) Each of the players have a locker
b) Each of the players has a locker
c) Each of the players having a locker
d) Each of the player has a locker

2. Which is a correctly formed question in indirect speech?
a) He asked that where I lived
b) He asked where I lived
c) He asked where did I live
d) He asked that where did I lived

Answer Key

1-b 2-b

Week 10 Mock Test

Two short tests to close out Week 10: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 10 Only

1. Choose the correctly punctuated sentence:
a) Its a nice day
b) It's a nice day
c) Its' a nice day
d) Its a, nice day

2. "We are trying to separate the wheat from the chaff" uses language in a ___ sense.
a) Literal
b) Figurative
c) Poetic
d) Technical

3. Choose the correct sentence:
a) He don't know the answer
b) He doesn't know the answer
c) He not knows the answer
d) He doesn't knows the answer

4. Synonym of "Meticulous":
a) Careless
b) Careful and precise
c) Fast
d) Lazy

5. "She said she ___ come the next day." (reported from "I will come tomorrow")
a) will
b) would
c) can
d) shall

6. Choose the grammatically correct sentence:
a) Each of the players have a locker
b) Each of the players has a locker
c) Each of the players having a locker
d) Each of the player has a locker

7. Passive form of "The scientist discovered a new species":
a) A new species discovered the scientist
b) A new species was discovered by the scientist
c) A new species is discovering the scientist

d) A new species discovers the scientist

8. Antonym of "Genuine":
a) Authentic
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a) from
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a) Least important detail
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c) Longest sentence
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a) He asked that where I lived
b) He asked where I lived
c) He asked where did I live
d) He asked that where did I lived

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a) Occassion
b) Occasion
c) Ocasion
d) Occaision

14. Choose the sentence free of errors:
a) He is one of the boy who plays well
b) He is one of the boys who play well
c) He is one of the boys who plays well
d) He one of the boys play well

15. Correct indirect question: 'Why are you late?' he asked.
a) He asked why I was late
b) He asked why was I late
c) He asked that why I was late
d) He asked why am I late

16. Identify the correctly spelled word:
a) Definately
b) Definitely
c) Definitly
d) Difinitely

Answer Key

1-b 2-b 3-b 4-b 5-b 6-b 7-b 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-a 16-b

Part B — Cumulative, Weeks 1-10

1. Choose the correctly spelled word:
a) Recieve
b) Receive
c) Receeve
d) Receve

2. "When I was in Kathmandu, I had to work very hard." The underlined word 'hard' here functions as a(n):
a) Noun
b) Adjective
c) Adverb
d) Preposition

3. Identify the part of speech of the underlined word: "She sings beautifully."
a) Noun
b) Verb
c) Adverb
d) Preposition

4. Choose the correct tense: "She ___ to school every day."
a) go
b) goes
c) going
d) gone

5. "Each of the students ___ submitted their assignment." The correct verb is:
a) have
b) has
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d) had have

6. "Neither the manager nor the assistants ___ how the fire started."
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b) have known
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d) were knowing

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a) The meal cooks the chef
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c) The meal is cooked by the chef
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9. "A policeman shot him dead in the early morning." In passive-friendly restatement, this means:
a) He is shot dead by a policeman in the early morning
b) He was shot dead in the early morning
c) He in the early morning was shot dead
d) In the early morning was shot dead him

10. Change to indirect speech: He said, "I am tired."
a) He said that he is tired
b) He said that he was tired
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11. He enquired, "Where did I study?" becomes:
a) He enquired that where I studied
b) He enquired where I studied
c) He enquired where I will study
d) He enquired that where I will study

12. Change to indirect speech: She said, "I will go tomorrow."
a) She said that she will go tomorrow
b) She said that she would go the next day
c) She said she goes tomorrow
d) She said that she has gone tomorrow

13. Identify the error: "Each of the students have submitted their assignment."
a) Each
b) have
c) their
d) submitted

14. Identify the error: "She don't like coffee."
a) She
b) don't
c) like
d) coffee

15. Identify the error: "He is good on mathematics."
a) He

b) is good
c) on
d) mathematics

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c) Rare
d) Limited

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b) Careless
c) Precise
d) Detailed

22. "The letter ___ by her yesterday." (correct passive, past simple)
a) is written
b) was written
c) has been written
d) will be written

23. "He said that he ___ finished the work." (past perfect, from 'I have finished')
a) has
b) have

c) had
d) was

24. Choose the grammatically correct sentence:
a) She don't like tea
b) She doesn't likes tea
c) She doesn't like tea
d) She not like tea

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c) Confusing
d) Forbidden

28. Choose the correctly punctuated sentence:
a) Its a nice day
b) It's a nice day
c) Its' a nice day
d) Its a, nice day

29. "We are trying to separate the wheat from the chaff" uses language in a ___ sense.
a) Literal
b) Figurative
c) Poetic
d) Technical

30. Choose the correct sentence:
a) He don't know the answer
b) He doesn't know the answer
c) He not knows the answer
d) He doesn't knows the answer

Answer Key

1-b 2-c 3-c 4-b 5-b 6-c 7-a 8-b 9-b 10-b 11-b 12-b 13-b 14-b 15-c 16-b 17-b 18-a 19-b 20-b 21-b 22-b 23-c 24-c 25-b 26-b 27-b 28-b 29-b 30-b

Technical English — Solved Problem Bank

A set of fully worked problems spanning the whole subject, useful for a final confidence check before moving to the next part. Try each problem yourself before reading the solution.

Problem 1: Convert to passive voice: 'The committee will announce the results tomorrow.'

Solution: *Identify the object (the results) as the new subject, use 'will be' + past participle, and optionally add the agent: 'The results will be announced by the committee tomorrow.'*

Problem 2: Convert to indirect speech: He said, "I have finished my homework."

Solution: *The reporting verb 'said' is past tense, so present perfect ('have finished') shifts to past perfect: 'He said that he had finished his homework.'*

Problem 3: Identify and correct the error: 'Between you and I, this is a great idea.'

Solution: *Prepositions like 'between' take object pronouns, not subject pronouns — 'I' should be 'me': 'Between you and me, this is a great idea.'*

Problem 4: Choose the correct word: 'The effect/affect of the new policy was significant.'

Solution: *'Effect' is normally a noun meaning result; 'affect' is normally a verb meaning to influence. Since a noun is needed here, the correct choice is 'effect.'*

Problem 5: Identify the figure of speech in: 'The stars danced in the night sky.'

Solution: *Giving human actions (dancing) to non-human things (stars) is personification.*

Problem 6: Correct the sentence: 'Neither the teacher nor the students was ready.'

Solution: *When 'neither...nor' joins a singular and plural subject, the verb agrees with the nearer subject — 'students' (plural), so the verb should be 'were': 'Neither the teacher nor the students were ready.'*

Problem 7: Convert to active voice: 'The novel was written by an unknown author in 1850.'

Solution: *Make the original agent the subject and the object of the passive sentence the new object: 'An unknown author wrote the novel in 1850.'*

Problem 8: Identify the correctly punctuated sentence among: (a) Its raining, (b) It's raining.

Solution: *'It's' is the contraction of 'it is,' which fits the intended meaning here, so (b) 'It's raining' is correct; 'Its' (no apostrophe) is a possessive pronoun and would be wrong in this context.*

Problem 9: Find a synonym for 'meticulous' from context: 'She meticulously checked every line of code before submitting.'

Solution: *The context (checking every line carefully) supports 'careful and precise' as the meaning — synonyms include thorough, careful, precise, painstaking.*

Problem 10: Convert direct to indirect: She asked, "Can you help me?"

Solution: *Yes/no questions in indirect speech use 'if' or 'whether,' drop the question mark, and remove inversion: 'She asked if I could help her.'*

Problem 11: Identify the error: 'He is one of the best player in the team.'

Solution: *Since 'one of the best' implies a superlative comparison among many, the noun should be plural: 'He is one of the best players in the team.'*

Problem 12: Choose the correct word: 'The book, along with the pen and notebook, ___ on the table.' (is/are)

Solution: *The subject is 'the book' (singular); phrases like 'along with...' don't add to the grammatical subject count, so the verb stays singular: 'is'.*

Problem 13: Correct the sentence: 'She is one of those students who always does the homework.'

Solution: *The relative clause 'who...' refers to 'students' (plural), so the verb should agree with the plural: 'She is one of those students who always do the homework.'*

Problem 14: Identify the tone of a passage that uses phrases like 'unfortunately' and 'sadly' throughout.

Solution: *Repeated use of negative-connotation adverbs like 'unfortunately' and 'sadly' signals a pessimistic or regretful tone.*

Problem 15: Choose the correct form: 'If I ___ rich, I would travel the world.' (was/were)

Solution: *This is a hypothetical/subjunctive condition, which conventionally uses 'were' regardless of subject: 'If I were rich...'*

Problem 16: Identify the error: 'The number of students are increasing every year.'

Solution: *'The number of' is treated as singular (it's the number, not the students, that is the subject), so the verb should be 'is': 'The number of students is increasing every year.'*

Problem 17: Convert to passive: 'Someone stole my bicycle last night.'

Solution: *'Someone' becomes the omittable agent, and 'my bicycle' becomes the subject: 'My bicycle was stolen last night.'*

Problem 18: Identify the error: 'I would rather to go home now.'

Solution: *'Would rather' is followed by a bare infinitive (without 'to'): 'I would rather go home now.'*

Problem 19: Choose the correct word: 'The effect of the medicine was ___ (immediate/immediately).'

Solution: *Since a noun ('effect') needs an adjective to describe it, 'immediate' is correct: 'The effect...was immediate.'*

Problem 20: Convert to passive: 'They are painting the house.'

Solution: *'The house is being painted (by them).'*

Problem 21: Identify the error: 'He is the most cleverest boy in the class.'

Solution: *Using both 'most' and the superlative '-est' together is redundant: it should be either 'the cleverest' or 'the most clever'.*

Problem 22: Choose the correct preposition: 'She succeeded ___ passing the exam.'

Solution: *'Succeed in' is the correct idiomatic pairing: 'She succeeded in passing the exam.'*

Technical English — Glossary of Key Terms

A quick-reference glossary. Read through it once, then use it to test yourself: cover the definitions and try to recall each one from the term alone.

Term	Definition
Active Voice	A sentence structure where the subject performs the action of the verb.
Antonym	A word with the opposite meaning to another word.
Clause	A group of words containing a subject and a verb, forming part or all of a sentence.
Conjunction	A word that joins words, phrases, or clauses together.
Direct Speech	Reporting the exact words a speaker used, enclosed in quotation marks.
Indirect (Reported) Speech	Reporting what someone said without quoting their exact words, typically with tense/pronoun shifts.
Inference	A conclusion drawn from evidence/reasoning rather than from an explicit statement.
Passive Voice	A sentence structure where the subject receives the action of the verb.
Preposition	A word showing the relationship between a noun/pronoun and other words in a sentence (e.g. in, on, at).
Pronoun	A word that stands in for a noun (e.g. he, she, it, they).
Subject-Verb Agreement	The grammatical rule that a verb must match its subject in number (singular/plural).
Synonym	A word with the same or nearly the same meaning as another word.
Tense	The form of a verb indicating the time (past, present, future) of an action.
Tone	The author's attitude toward the subject, conveyed through word choice and style.
Adjective	A word that describes or modifies a noun.
Adverb	A word that modifies a verb, adjective, or another adverb, often describing how, when, or where.
Article	The words 'a', 'an', and 'the', used to specify nouns.
Idiom	A phrase whose meaning isn't deducible from the literal meaning of its individual words.
Noun	A word naming a person, place, thing, or idea.
Idiom	A phrase whose meaning isn't deducible from the literal meaning of its individual words.
Superlative	The grammatical form expressing the highest degree of a quality (e.g. 'best', 'tallest').
Redundancy (grammar)	Unnecessary repetition of meaning, such as using two words that express the same idea.
Infinitive	The base form of a verb, often preceded by 'to' (e.g. 'to run'), though some constructions use the bare form.

PART 5

Logical Reasoning

Logical Reasoning carries 15 of the 100 marks and rewards pattern recognition and structured thinking rather than memorized facts — it is often the fastest section to improve significantly with focused practice. This part covers number series, coding-decoding, blood relations, direction sense, seating arrangements, puzzles, and critical reasoning, organized week by week.

This part is organized as 10 weeks of 6 study days each (60 days total), matching a Monday-to-Saturday study rhythm with Sunday reserved for mixed review across all five subjects (see Part 6).

Week 1: Number Series

Use this log to track your Logical Reasoning study sessions for Week 1. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Solving Number Series

Solving Number Series

Number series questions give a sequence and ask you to find the next term(s) or a missing term. Common patterns: constant difference (arithmetic, e.g. 2,4,6,8 → +2 each time), constant ratio (geometric, e.g. 2,4,8,16 → ×2 each time), differences that themselves form a series (e.g. 1,2,4,7,11 → differences are 1,2,3,4), alternating operations (e.g. +3,−1,+3,−1...), and squares/cubes (1,4,9,16,25 = n^2).

Additional Practice Example: Find the next term: 2, 5, 10, 17, 26, ?

Solution: *The differences are 3, 5, 7, 9 (increasing odd numbers). The next difference should be 11, giving 26+11 = 37.*

Day 1 Quiz

1. Find the next number: 2, 4, 8, 16, __

a) 18
b) 24
c) 32
d) 20

2. Find the missing number: 5, 10, 20, 40, ?

a) 60
b) 80
c) 50
d) 45

3. A is B's father. B is C's mother. What is A to C?

a) Father
b) Grandfather
c) Uncle
d) Brother

Answer Key

1-c 2-b 3-b

Day 2 — Solving Number Series

Solving Number Series

Strategy: first check simple addition/subtraction between consecutive terms; if that's not constant, check ratios; if neither works, check the differences-of-differences (second-order pattern), or look for two interleaved series (odd positions follow one rule, even positions follow another).

Additional Practice Example: If in a code 'GARDEN' is written as 'HBSEFO' (each letter +1), decode 'IFMMP'.
Solution: *Reverse the shift by subtracting 1 from each letter: I→H, F→E, M→L, M→L, P→O, giving 'HELLO'.*

Day 2 Quiz

1. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

2. Find the next term: 100, 50, 25, 12.5, ?
a) 6.25
b) 10
c) 5
d) 0

3. Find the next number: 5, 10, 15, 20, ?
a) 22
b) 25
c) 24
d) 30

Answer Key

1-b 2-a 3-b

Day 3 — Solving Number Series

Solving Number Series

Worked Example: 3, 9, 27, 81, ? — each term ×3, so next = 243.

Additional Practice Example: A is B's mother. C is B's son. What is A to C?

Solution: *A is B's mother, and C is B's son (so B is C's parent). A is therefore the grandmother of C.*

Day 3 Quiz

1. Which number should replace the question mark: 3, 9, 27, 81, ?

a) 162
b) 243
c) 324
d) 729

2. Find the missing number: 2, 6, 12, 20, ?

a) 28
b) 30
c) 32
d) 24

3. If each letter shifts -1, 'BOY' becomes:

a) ANX
b) CPZ
c) ANY
d) AOX

Answer Key

1-b 2-b 3-a

Day 4 — Solving Number Series (Review)

Solving Number Series

Number series questions give a sequence and ask you to find the next term(s) or a missing term. Common patterns: constant difference (arithmetic, e.g. 2,4,6,8 → +2 each time), constant ratio (geometric, e.g. 2,4,8,16 → ×2 each time), differences that themselves form a series (e.g. 1,2,4,7,11 → differences are 1,2,3,4), alternating operations (e.g. +3,−1,+3,−1...), and squares/cubes (1,4,9,16,25 = n^2).

Additional Practice Example: A man walks 6 km east, turns right, walks 4 km, turns right again, walks 6 km. How far is he from his start, and in what direction?
Solution: *East 6 km (facing East), turn right → facing South, walk 4 km. Turn right again → facing West, walk 6 km. The eastward and westward legs (6 km each) cancel out entirely, leaving only the 4 km southward leg — he is 4 km south (in the south direction) of the start.*

Day 4 Quiz

1. Find the missing term: 7, 14, 28, 56, ?
a) 84
b) 112
c) 100
d) 98

2. Find the next term in: 1, 1, 2, 3, 5, 8, ? (Fibonacci)
a) 11
b) 12
c) 13
d) 10

3. A is B's father. B is C's mother. What is A to C?
a) Father
b) Grandfather
c) Uncle
d) Brother

Answer Key

1-b 2-c 3-b

Day 5 — Solving Number Series (Review)

Solving Number Series

Strategy: first check simple addition/subtraction between consecutive terms; if that's not constant, check ratios; if neither works, check the differences-of-differences (second-order pattern), or look for two interleaved series (odd positions follow one rule, even positions follow another).

Additional Practice Example: Five people P,Q,R,S,T sit in a row. Q is second from the left. P is immediately right of Q. T is at the right end. Where can R and S sit?

Solution: *Positions 1-5 from left. Q is at position 2. P is at position 3 (immediately right of Q). T is at position 5. That leaves positions 1 and 4 for R and S in some order — the exact assignment needs an additional clue to fully resolve, but both must occupy positions 1 and 4.*

Day 5 Quiz

1. Look for the pattern: 8, 11, 21, 15, 18, 21, 22. What comes next?

a) 25, 18
b) 25, 29
c) 25, 21
d) 24, 21

2. Find the next number: 1, 3, 6, 10, 15, ?

a) 18
b) 20
c) 21
d) 24

Answer Key

1-c 2-c

Day 6 — Solving Number Series (Review)

Solving Number Series

Worked Example: 3, 9, 27, 81, ? — each term ×3, so next = 243.

Additional Practice Example: Complete the analogy: Ounce : Weight :: Litre : ___
Solution: *Following the pattern 'unit : quantity it measures', Litre measures Volume.*

Day 6 Quiz

1. Find the next term: 1, 2, 4, 7, 11, ?
a) 14
b) 15
c) 16
d) 18

2. If in a code, each letter shifts back by 2, 'FISH' becomes:
a) DGQF
b) DGQE
c) DGRF
d) EGQF

Answer Key

1-c 2-a

Week 1 Mock Test

Two short tests to close out Week 1: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 1 Only

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. Find the missing term: 7, 14, 28, 56, ?
a) 84
b) 112
c) 100
d) 98

5. Look for the pattern: 8, 11, 21, 15, 18, 21, 22. What comes next?
a) 25, 18
b) 25, 29
c) 25, 21
d) 24, 21

6. Find the next term: 1, 2, 4, 7, 11, ?
a) 14
b) 15
c) 16
d) 18

7. Find the missing number: 5, 10, 20, 40, ?
a) 60
b) 80
c) 50

d) 45

8. Find the next term: 100, 50, 25, 12.5, ?
a) 6.25
b) 10
c) 5
d) 0

9. Find the missing number: 2, 6, 12, 20, ?
a) 28
b) 30
c) 32
d) 24

10. Find the next term in: 1, 1, 2, 3, 5, 8, ? (Fibonacci)
a) 11
b) 12
c) 13
d) 10

11. Find the next number: 1, 3, 6, 10, 15, ?
a) 18
b) 20
c) 21
d) 24

12. If in a code, each letter shifts back by 2, 'FISH' becomes:
a) DGQF
b) DGQE
c) DGRF
d) EGQF

13. A is B's father. B is C's mother. What is A to C?
a) Father
b) Grandfather
c) Uncle
d) Brother

14. Find the next number: 5, 10, 15, 20, ?
a) 22
b) 25
c) 24
d) 30

15. If each letter shifts -1, 'BOY' becomes:
a) ANX
b) CPZ
c) ANY
d) AOX

16. A is B's father. B is C's mother. What is A to C?

a) Father
b) Grandfather
c) Uncle
d) Brother

Answer Key

1-c 2-b 3-b 4-b 5-c 6-c 7-b 8-a 9-b 10-c 11-c 12-a 13-b 14-b 15-a 16-b

Part B — Cumulative, Weeks 1-1

1. Find the next number: 2, 4, 8, 16, __

a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?

a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?

a) 162
b) 243
c) 324
d) 729

Answer Key

1-c 2-b 3-b

Week 2: Coding-Decoding

Use this log to track your Logical Reasoning study sessions for Week 2. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Coding-Decoding Techniques

Coding-Decoding Techniques

Coding-decoding questions encode words/letters using a hidden rule (often a fixed letter shift) and ask you to apply the same rule to a new word. The most common rule: each letter is shifted forward or backward in the alphabet by a fixed number of positions.

Additional Practice Example: Statement: All squares are rectangles. All rectangles have four sides. Conclusion: All squares have four sides.

Solution: *This is a valid syllogism: since every square is a rectangle (first premise), and every rectangle has four sides (second premise), it necessarily follows that every square has four sides. The conclusion is TRUE and validly follows.*

Day 1 Quiz

1. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

2. If PENCIL is coded as QFODJM (each letter +1), how is BOOK coded?
a) CPPL
b) CPOL
c) BPPL
d) CPLL

3. Complete the analogy: Wheel : Car :: Wing : ___
a) Bird
b) Fly
c) Sky
d) Feather

Answer Key

1-a 2-a 3-a

Day 2 — Coding-Decoding Techniques

Coding-Decoding Techniques

Strategy: compare each letter of the code to the corresponding letter of the original word, note the shift (+1, +2, −1, etc.), confirm the SAME shift applies to every letter, then apply it to the new word. Some questions use reverse-order coding, or number-substitution (A=1, B=2...) instead of shifting.

Additional Practice Example: Find the odd one out: Kilogram, Litre, Metre, Gram.
Solution: *Kilogram and Gram measure mass, Metre measures length, and Litre measures volume — but if grouping by 'is a mass unit', Litre and Metre are the two non-mass units; the single cleanest classification is that Litre measures volume while the other three (Kilogram, Gram, Metre — though Metre is length) — reconsidering, the cleanest odd-one-out is Litre, since Kilogram and Gram are both mass units and Metre, while a different quantity, is at least a base SI unit like the gram; the most defensible single answer is Litre (the only volume unit).*

Day 2 Quiz

1. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

2. If in a code 'RAIN' is written as 'SBJO', the shift used is:
a) +1
b) +2
c) -1
d) -2

3. A man walks 3 km south, 3 km west. His distance from start is closest to:
a) 3 km
b) 4.2 km
c) 6 km
d) 0 km

Answer Key
1-a 2-a 3-b

Day 3 — Coding-Decoding Techniques

Coding-Decoding Techniques

Worked Example: If CAT → DBU, each letter shifts +1 (C→D, A→B, T→U). Applying the same rule to DOG: D→E, O→P, G→H, giving EPH.

Additional Practice Example: If facing North-East and you turn 90° clockwise, which direction do you face?

Solution: *Rotating 90° clockwise from North-East lands you on South-East (each 90° clockwise turn moves you two positions around an 8-point compass, or equivalently, directly perpendicular to the original diagonal direction).*

Day 3 Quiz

1. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

2. If HELLO is coded as IFMMP, what is the code for WORLD?
a) XPSME
b) XPSMD
c) WPSME
d) XPRME

3. Find the odd one out:
a) Green
b) Blue
c) Red
d) Table

Answer Key

1-a 2-a 3-d

Day 4 — Coding-Decoding Techniques (Review)

Coding-Decoding Techniques

Coding-decoding questions encode words/letters using a hidden rule (often a fixed letter shift) and ask you to apply the same rule to a new word. The most common rule: each letter is shifted forward or backward in the alphabet by a fixed number of positions.

Additional Practice Example: Six friends sit around a circular table facing the center. A is opposite D. B is to the immediate right of A. Where is B relative to D?

Solution: *Since A and D are opposite each other, and B is immediately right of A, B is immediately to the LEFT of D (opposite relationships reverse left/right when moving to the other side of the circle).*

Day 4 Quiz

1. If A=1, B=2, C=3... then the code for 'CAB' is:
a) 3-1-2
b) 1-2-3
c) 2-1-3
d) 3-2-1

2. Coding-decoding questions most commonly rely on:
a) Random substitution
b) A fixed, consistent letter-shift rule
c) Grammar rules
d) Number sequences only

3. Complete the analogy: Chef : Kitchen :: Pilot : ___
a) Airport
b) Cockpit
c) Sky
d) Plane

Answer Key

1-a 2-b 3-b

Day 5 — Coding-Decoding Techniques (Review)

Coding-Decoding Techniques

Strategy: compare each letter of the code to the corresponding letter of the original word, note the shift (+1, +2, −1, etc.), confirm the SAME shift applies to every letter, then apply it to the new word. Some questions use reverse-order coding, or number-substitution (A=1, B=2...) instead of shifting.

Additional Practice Example: Find the next term: 3, 7, 15, 31, ?
Solution: *The pattern is ×2 then +1 each time (3×2+1=7, 7×2+1=15, 15×2+1=31), so the next term is 31×2+1 = 63.*

Day 5 Quiz

1. If 'DOG' is coded as 'FQI' (shift +2), then 'CAT' would be coded as:
a) EBV
b) ECV
c) EBW
d) ECW

2. A man walks 7 km south then 7 km west. His distance from start is closest to:
a) 7 km
b) 9.9 km
c) 14 km
d) 0 km

Answer Key

1-a 2-b

Day 6 — Coding-Decoding Techniques (Review)

Coding-Decoding Techniques

Worked Example: If CAT → DBU, each letter shifts +1 (C→D, A→B, T→U). Applying the same rule to DOG: D→E, O→P, G→H, giving EPH.

Additional Practice Example: If in a code 'FRIEND' becomes 'EQHDMC' (each letter −1), decode 'DSFBM'.

Solution: *Reverse by adding 1 to each letter: D→E, S→T, F→G, B→C, M→N, giving 'ETGCN' — checking against likely intended word patterns, this shift-back method decodes consistently letter by letter regardless of whether the result forms a common word.*

Day 6 Quiz

1. In a reverse-letter code, if the alphabet is reversed (A=Z, B=Y...), what does 'A' code to?

a) A
b) Z
c) B
d) Y

2. Find the odd one out:

a) Red
b) Blue
c) Green
d) Heavy

Answer Key

1-b 2-d

Week 2 Mock Test

Two short tests to close out Week 2: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 2 Only

1. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

2. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

3. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

4. If A=1, B=2, C=3... then the code for 'CAB' is:
a) 3-1-2
b) 1-2-3
c) 2-1-3
d) 3-2-1

5. If 'DOG' is coded as 'FQI' (shift +2), then 'CAT' would be coded as:
a) EBV
b) ECV
c) EBW
d) ECW

6. In a reverse-letter code, if the alphabet is reversed (A=Z, B=Y...), what does 'A' code to?
a) A
b) Z
c) B
d) Y

7. If PENCIL is coded as QFODJM (each letter +1), how is BOOK coded?
a) CPPL
b) CPOL
c) BPPL

d) CPLL

8. If in a code 'RAIN' is written as 'SBJO', the shift used is:
a) +1
b) +2
c) -1
d) -2

9. If HELLO is coded as IFMMP, what is the code for WORLD?
a) XPSME
b) XPSMD
c) WPSME
d) XPRME

10. Coding-decoding questions most commonly rely on:
a) Random substitution
b) A fixed, consistent letter-shift rule
c) Grammar rules
d) Number sequences only

11. A man walks 7 km south then 7 km west. His distance from start is closest to:
a) 7 km
b) 9.9 km
c) 14 km
d) 0 km

12. Find the odd one out:
a) Red
b) Blue
c) Green
d) Heavy

13. Complete the analogy: Wheel : Car :: Wing : ___
a) Bird
b) Fly
c) Sky
d) Feather

14. A man walks 3 km south, 3 km west. His distance from start is closest to:
a) 3 km
b) 4.2 km
c) 6 km
d) 0 km

15. Find the odd one out:
a) Green
b) Blue
c) Red
d) Table

16. Complete the analogy: Chef : Kitchen :: Pilot : ___
a) Airport
b) Cockpit
c) Sky
d) Plane

Answer Key

1-a 2-a 3-a 4-a 5-a 6-b 7-a 8-a 9-a 10-b 11-b 12-d 13-a 14-b 15-d 16-b

Part B — Cumulative, Weeks 1-2

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a

Week 3: Blood Relations

Use this log to track your Logical Reasoning study sessions for Week 3. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Solving Blood Relation Puzzles

Solving Blood Relation Puzzles

Blood relation questions describe family connections through a chain of statements and ask how two people are related. The key technique is drawing a quick family tree diagram as you read — using '+' for male, '-' for female, and arrows for parent→child — rather than trying to hold the whole chain in your head.

Additional Practice Example: A is the brother of B. B is the daughter of C. D is C's husband. How is D related to A?

Solution: *C is B's mother, and D is C's husband, so D is B's father. Since A is B's brother, D is also A's father.*

Day 1 Quiz

1. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?

a) Mother
b) Aunt
c) Sister
d) Grandmother

2. If 'A + B' means A is the father of B, and 'A - B' means A is the mother of B, what does 'P + Q - R' mean?

a) P is the grandfather of R
b) P is the father of R
c) Q is the father of R
d) R is the father of P

3. If facing South-West and turning 90° clockwise, you now face:

a) North-West
b) North-East
c) South-East
d) South-West

Answer Key

1-a 2-a 3-b

Day 2 — Solving Blood Relation Puzzles

Solving Blood Relation Puzzles

Common relation chains to memorize instantly: Father's/Mother's son = Brother (or self); Father's/Mother's daughter = Sister (or self); Mother's/Father's brother = Uncle; Mother's/Father's sister = Aunt; Son's/Daughter's spouse = Daughter-in-law/Son-in-law; Sibling's child = Niece/Nephew.

Additional Practice Example: A man walks 10 km north, then 10 km east, then 10 km south. Find his distance and direction from start.

Solution: *The north and south legs (10 km each) cancel out, leaving only the 10 km eastward leg — he is 10 km east of the starting point.*

Day 2 Quiz

1. A is the father of B. C is the sister of A. What is C to B?

a) Mother
b) Aunt
c) Sister
d) Grandmother

2. A woman introduces a man as "the son of my mother's only daughter." If the woman has no sisters, how is the man related to her?

a) Brother
b) Son
c) Nephew
d) Cousin

3. Statement: All birds fly. Penguins are birds. Conclusion: Penguins fly. Is this a valid syllogism (regardless of real-world truth)?

a) Yes, validly follows from the premises
b) No, invalid
c) Cannot be determined
d) Irrelevant

Answer Key

1-b 2-b 3-a

Day 3 — Solving Blood Relation Puzzles

Solving Blood Relation Puzzles

Worked Example: 'A is the father of B. C is the sister of A.' → C is A's sister, so C is B's aunt (father's sister = paternal aunt).

Additional Practice Example: Complete the analogy: Author : Manuscript :: Composer : ___
Solution: *Following 'creator : their created work', a Composer creates a Symphony (or musical Score).*

Day 3 Quiz

1. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father
b) Brother
c) Uncle
d) Cousin

2. M is the sister of N. N is the brother of O. O is the father of P. How is M related to P?
a) Mother
b) Aunt
c) Grandmother
d) Sister

3. Find the next term: 81, 27, 9, 3, ?
a) 0
b) 1
c) 1.5
d) 2

Answer Key

1-b 2-b 3-b

Day 4 — Solving Blood Relation Puzzles (Review)

Solving Blood Relation Puzzles

Blood relation questions describe family connections through a chain of statements and ask how two people are related. The key technique is drawing a quick family tree diagram as you read — using '+' for male, '-' for female, and arrows for parent→child — rather than trying to hold the whole chain in your head.

Additional Practice Example: Statement: No cats are dogs. All dogs are animals. Conclusion: No cats are animals. Is this valid?

Solution: *This conclusion is INVALID. The premises only tell us cats aren't dogs and dogs are animals — they say nothing preventing cats from also being animals (which, in reality, they are). The conclusion does not follow.*

Day 4 Quiz

1. A's father is B's son. How is B related to A?
a) Father
b) Grandfather
c) Brother
d) Uncle

2. In a family, A is B's husband, and C is A's mother. How is C related to B?
a) Sister-in-law
b) Mother-in-law
c) Aunt
d) Grandmother

3. Facing North-East and turning 90° clockwise, you face:
a) North-West
b) South-East
c) South-West
d) North

Answer Key

1-b 2-b 3-b

Day 5 — Solving Blood Relation Puzzles (Review)

Solving Blood Relation Puzzles

Common relation chains to memorize instantly: Father's/Mother's son = Brother (or self); Father's/Mother's daughter = Sister (or self); Mother's/Father's brother = Uncle; Mother's/Father's sister = Aunt; Son's/Daughter's spouse = Daughter-in-law/Son-in-law; Sibling's child = Niece/Nephew.

Additional Practice Example: In a row of 7 people, P is 3rd from the left and 3rd from the right. Is this possible, and what does it imply?

Solution: *For a row of 7, being 3rd from the left means position 3, and 3rd from the right in a 7-person row also means position 5 (7−3+1=5) — these do not match, so this scenario is impossible unless P is exactly in the middle (position 4) of an odd-length row of 7, which would make P 4th from both ends, not 3rd — so the given condition is inconsistent for a row of exactly 7.*

Day 5 Quiz

1. Pointing to a photograph, a man said, "She is the daughter of my grandfather's only son." How is the woman related to the man?

a) Mother
b) Sister
c) Aunt
d) Daughter

2. Statement: All athletes are fit. Some fit people are fast. Conclusion: Some athletes are fast. This is:

a) True
b) False
c) Cannot be determined
d) Always true

Answer Key

1-b 2-c

Day 6 — Solving Blood Relation Puzzles (Review)

Solving Blood Relation Puzzles

Worked Example: 'A is the father of B. C is the sister of A.' → C is A's sister, so C is B's aunt (father's sister = paternal aunt).

Additional Practice Example: Find the odd one out: Square, Cube, Rectangle, Circle.
Solution: *Cube is a 3-dimensional solid, while Square, Rectangle, and Circle are all 2-dimensional shapes — Cube is the odd one out.*

Day 6 Quiz

1. P is Q's brother. R is Q's mother. S is R's father. How is P related to S?
a) Son
b) Grandson
c) Father
d) Brother

2. Find the next term: 100, 90, 81, 73, ?
a) 66
b) 65
c) 64
d) 67

Answer Key

1-b 2-a

Week 3 Mock Test

Two short tests to close out Week 3: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 3 Only

1. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?

a) Mother
b) Aunt
c) Sister
d) Grandmother

2. A is the father of B. C is the sister of A. What is C to B?

a) Mother
b) Aunt
c) Sister
d) Grandmother

3. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?

a) Father
b) Brother
c) Uncle
d) Cousin

4. A's father is B's son. How is B related to A?

a) Father
b) Grandfather
c) Brother
d) Uncle

5. Pointing to a photograph, a man said, "She is the daughter of my grandfather's only son." How is the woman related to the man?

a) Mother
b) Sister
c) Aunt
d) Daughter

6. P is Q's brother. R is Q's mother. S is R's father. How is P related to S?

a) Son
b) Grandson
c) Father
d) Brother

7. If 'A + B' means A is the father of B, and 'A - B' means A is the mother of B, what does 'P + Q - R' mean?

a) P is the grandfather of R
b) P is the father of R
c) Q is the father of R
d) R is the father of P

8. A woman introduces a man as "the son of my mother's only daughter." If the woman has no sisters, how is the man related to her?
a) Brother
b) Son
c) Nephew
d) Cousin

9. M is the sister of N. N is the brother of O. O is the father of P. How is M related to P?
a) Mother
b) Aunt
c) Grandmother
d) Sister

10. In a family, A is B's husband, and C is A's mother. How is C related to B?
a) Sister-in-law
b) Mother-in-law
c) Aunt
d) Grandmother

11. Statement: All athletes are fit. Some fit people are fast. Conclusion: Some athletes are fast. This is:
a) True
b) False
c) Cannot be determined
d) Always true

12. Find the next term: 100, 90, 81, 73, ?
a) 66
b) 65
c) 64
d) 67

13. If facing South-West and turning 90° clockwise, you now face:
a) North-West
b) North-East
c) South-East
d) South-West

14. Statement: All birds fly. Penguins are birds. Conclusion: Penguins fly. Is this a valid syllogism (regardless of real-world truth)?
a) Yes, validly follows from the premises
b) No, invalid
c) Cannot be determined
d) Irrelevant

15. Find the next term: 81, 27, 9, 3, ?
a) 0
b) 1
c) 1.5
d) 2

16. Facing North-East and turning 90° clockwise, you face:
a) North-West
b) South-East
c) South-West
d) North

Answer Key

1-a 2-b 3-b 4-b 5-b 6-b 7-a 8-b 9-b 10-b 11-c 12-a 13-b 14-a 15-b 16-b

Part B — Cumulative, Weeks 1-3

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO

b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?
a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?
a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father
b) Brother
c) Uncle
d) Cousin

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b

Week 4: Direction Sense

Use this log to track your Logical Reasoning study sessions for Week 4. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Direction Sense Techniques

Direction Sense Techniques

Direction problems track movement (e.g. 'walks 5 km north, then 3 km east...') and ask for the final direction or straight-line distance from the start. Always sketch a compass and plot each move step by step on paper.

Additional Practice Example: A is North of B. C is East of B. What direction is C from A?
Solution: *Since C is east of B, and A is directly north of B, C is South-East of A.*

Day 1 Quiz

1. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

2. Two 90° right turns in succession bring you to face:
a) The same direction you started
b) The opposite direction
c) 90° left of start
d) No consistent direction

3. Fact: All members of Club X pay dues. Some members are students. Which must be true? Some students pay dues.
a) True
b) False
c) Cannot be determined
d) Always false

Answer Key

1-b 2-b 3-a

Day 2 — Direction Sense Techniques

Direction Sense Techniques

For final distance, once you've plotted the path, the straight-line (displacement) distance between start and end points can be found using the Pythagorean theorem if the net movement forms a right angle, or by simply canceling opposite-direction movements (e.g. 5 km north then 5 km south cancels out entirely).

Additional Practice Example: Complete the series: J, F, M, A, M, ? (first letters of months)
Solution: *January, February, March, April, May, so next is June: J.*

Day 2 Quiz

1. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

2. A man walks 6 km west, then 6 km north. His distance from the starting point is approximately:
a) 6 km
b) 8.5 km
c) 12 km
d) 0 km

3. P is Q's daughter. R is P's brother. How is R related to Q?
a) Son
b) Grandson
c) Father
d) Uncle

Answer Key

1-a 2-b 3-a

Day 3 — Direction Sense Techniques

Direction Sense Techniques

Rotation rules: turning 90° clockwise from facing North puts you facing East; from East, facing South; from South, facing West; from West, facing North. A left turn is 90° counter-clockwise; a right turn is 90° clockwise (when facing the standard direction).

Additional Practice Example: Statement: Some cats are black. All black things absorb heat. Conclusion: Some cats absorb heat. Is this valid?

Solution: *Yes, this is valid: since some cats are (in the category of) black things, and all black things absorb heat, those specific cats must absorb heat.*

Day 3 Quiz

1. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

2. If facing East and you turn 90° counter-clockwise (left), you face:
a) South
b) West
c) North
d) East

3. Complete the analogy: Sculptor : Chisel :: Painter : ___
a) Canvas
b) Brush
c) Gallery
d) Frame

Answer Key

1-b 2-c 3-b

Day 4 — Direction Sense Techniques (Review)

Direction Sense Techniques

Direction problems track movement (e.g. 'walks 5 km north, then 3 km east...') and ask for the final direction or straight-line distance from the start. Always sketch a compass and plot each move step by step on paper.

Additional Practice Example: If in a code 'RIVER' becomes 'SJWFS' (each letter +1), what does 'OCEAN' become?
Solution: *Shift each letter forward by 1: O→P, C→D, E→F, A→B, N→O, giving 'PDFBO'.*

Day 4 Quiz

1. A man walks 4 km east and then 3 km north. What is his straight-line distance from the start?
a) 5 km
b) 7 km
c) 1 km
d) 6 km

2. A man walks north, turns right, walks some distance, turns right again. He is now facing:
a) North
b) South
c) East
d) West

3. Fact: All club members pay fees. Some students are club members. Which must be true?
a) Some students pay fees
b) All students pay fees
c) No students pay fees
d) Cannot relate students to fees at all

Answer Key

1-a 2-b 3-a

Day 5 — Direction Sense Techniques (Review)

Direction Sense Techniques

For final distance, once you've plotted the path, the straight-line (displacement) distance between start and end points can be found using the Pythagorean theorem if the net movement forms a right angle, or by simply canceling opposite-direction movements (e.g. 5 km north then 5 km south cancels out entirely).

Additional Practice Example: Find the next term: 2, 5, 10, 17, 26, ?
Solution: *The differences are 3, 5, 7, 9 (increasing odd numbers). The next difference should be 11, giving 26+11 = 37.*

Day 5 Quiz

1. If you are facing South and turn 180°, you now face:
a) East
b) West
c) North
d) South

2. P is the only son of Q. R is Q's mother. How is R related to P?
a) Mother
b) Grandmother
c) Aunt
d) Sister

Answer Key

1-c 2-b

Day 6 — Direction Sense Techniques (Review)

Direction Sense Techniques

Rotation rules: turning 90° clockwise from facing North puts you facing East; from East, facing South; from South, facing West; from West, facing North. A left turn is 90° counter-clockwise; a right turn is 90° clockwise (when facing the standard direction).

Additional Practice Example: If in a code 'GARDEN' is written as 'HBSEFO' (each letter +1), decode 'IFMMP'.

Solution: *Reverse the shift by subtracting 1 from each letter: I→H, F→E, M→L, M→L, P→O, giving 'HELLO'.*

Day 6 Quiz

1. A man walks 10 km south, then turns left and walks 5 km. Which direction is he now facing?

a) North
b) East
c) South
d) West

2. Which word logically completes: Author : Book :: Director : ___

a) Camera
b) Film
c) Actor
d) Studio

Answer Key

1-b 2-b

Week 4 Mock Test

Two short tests to close out Week 4: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 4 Only

1. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

2. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

3. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

4. A man walks 4 km east and then 3 km north. What is his straight-line distance from the start?
a) 5 km
b) 7 km
c) 1 km
d) 6 km

5. If you are facing South and turn 180°, you now face:
a) East
b) West
c) North
d) South

6. A man walks 10 km south, then turns left and walks 5 km. Which direction is he now facing?
a) North
b) East
c) South
d) West

7. Two 90° right turns in succession bring you to face:
a) The same direction you started
b) The opposite direction
c) 90° left of start

d) No consistent direction

8. A man walks 6 km west, then 6 km north. His distance from the starting point is approximately:
a) 6 km
b) 8.5 km
c) 12 km
d) 0 km

9. If facing East and you turn 90° counter-clockwise (left), you face:
a) South
b) West
c) North
d) East

10. A man walks north, turns right, walks some distance, turns right again. He is now facing:
a) North
b) South
c) East
d) West

11. P is the only son of Q. R is Q's mother. How is R related to P?
a) Mother
b) Grandmother
c) Aunt
d) Sister

12. Which word logically completes: Author : Book :: Director : ___
a) Camera
b) Film
c) Actor
d) Studio

13. Fact: All members of Club X pay dues. Some members are students. Which must be true? Some students pay dues.
a) True
b) False
c) Cannot be determined
d) Always false

14. P is Q's daughter. R is P's brother. How is R related to Q?
a) Son
b) Grandson
c) Father
d) Uncle

15. Complete the analogy: Sculptor : Chisel :: Painter : ___
a) Canvas
b) Brush
c) Gallery

d) Frame

16. Fact: All club members pay fees. Some students are club members. Which must be true?
a) Some students pay fees
b) All students pay fees
c) No students pay fees
d) Cannot relate students to fees at all

Answer Key

1-b 2-a 3-b 4-a 5-c 6-b 7-b 8-b 9-c 10-b 11-b 12-b 13-a 14-a 15-b 16-a

Part B — Cumulative, Weeks 1-4

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?

a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?

a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?

a) Father
b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?

a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?

a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:

a) West
b) East
c) South
d) North

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b 10-b 11-a 12-b

Week 5: Seating Arrangement

Use this log to track your Logical Reasoning study sessions for Week 5. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Solving Seating Arrangements

Solving Seating Arrangements

Seating arrangement puzzles describe relative positions of people around a table (linear or circular) and ask you to determine the full order or answer a specific positional question. The key technique: process the clues in order of specificity — fix the most definite statement first (e.g. 'X sits at one end'), then place relative clues around it, using elimination for anything ambiguous.

Additional Practice Example: A is B's mother. C is B's son. What is A to C?
Solution: *A is B's mother, and C is B's son (so B is C's parent). A is therefore the grandmother of C.*

Day 1 Quiz

1. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?
a) A
b) B
c) C
d) Cannot be determined

2. A statement says "M is not at either end." This tells you M is:
a) Definitely in the exact middle
b) Somewhere in the interior positions, exact spot unknown yet
c) At position 1
d) At the last position

3. A man starts facing North, turns left twice. He now faces:
a) North
b) South
c) East
d) West

Answer Key

1-b 2-b 3-b

Day 2 — Solving Seating Arrangements

Solving Seating Arrangements

For circular arrangements, remember 'left' and 'right' depend on whether people are facing inward or outward — read the question carefully for this detail, as it flips the entire arrangement.

Additional Practice Example: A man walks 6 km east, turns right, walks 4 km, turns right again, walks 6 km. How far is he from his start, and in what direction?

Solution: *East 6 km (facing East), turn right → facing South, walk 4 km. Turn right again → facing West, walk 6 km. The eastward and westward legs (6 km each) cancel out entirely, leaving only the 4 km southward leg — he is 4 km south (in the south direction) of the start.*

Day 2 Quiz

1. In a circular arrangement facing the center, 'left' of a person refers to:
a) The clockwise direction
b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

2. When solving seating puzzles with multiple clues, contradictory placements indicate:
a) A puzzle typo only
b) You should re-check your earlier deductions for an error
c) The puzzle has multiple valid answers always
d) Nothing significant

3. In a row of 8, if M is 3rd from the left, what position is M from the right?
a) 3rd
b) 5th
c) 6th
d) 4th

Answer Key

1-b 2-b 3-c

Day 3 — Solving Seating Arrangements

Solving Seating Arrangements

Worked Example: Five friends sit in a row. A is to the right of B, C is to the left of B. This fixes the order C-B-A for those three; the middle position among these three is B.

Additional Practice Example: Five people P,Q,R,S,T sit in a row. Q is second from the left. P is immediately right of Q. T is at the right end. Where can R and S sit?

Solution: *Positions 1-5 from left. Q is at position 2. P is at position 3 (immediately right of Q). T is at position 5. That leaves positions 1 and 4 for R and S in some order — the exact assignment needs an additional clue to fully resolve, but both must occupy positions 1 and 4.*

Day 3 Quiz

1. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?

a) 3 or 4
b) 2
c) 5
d) 6

2. In a circular table seating problem, how many distinct 'ends' does the table have?

a) 2
b) 1
c) 0
d) 4

3. Find the odd one out:

a) Monday
b) Wednesday
c) December
d) Friday

Answer Key

1-a 2-c 3-c

Day 4 — Solving Seating Arrangements (Review)

Solving Seating Arrangements

Seating arrangement puzzles describe relative positions of people around a table (linear or circular) and ask you to determine the full order or answer a specific positional question. The key technique: process the clues in order of specificity — fix the most definite statement first (e.g. 'X sits at one end'), then place relative clues around it, using elimination for anything ambiguous.

Additional Practice Example: Complete the analogy: Ounce : Weight :: Litre : ___
Solution: *Following the pattern 'unit : quantity it measures', Litre measures Volume.*

Day 4 Quiz

1. In seating puzzles, the most useful first step is to:
a) Guess an arrangement randomly
b) Fix the most definite/specific clue first
c) Ignore end-position clues
d) Start from the middle always

2. If clue 1 fixes a person's exact seat and clue 2 only gives a relative position, you should apply:
a) Clue 2 first
b) Clue 1 first, since it's more specific
c) Neither clue
d) Both clues simultaneously without order

3. A man starts facing South, turns right once. He now faces:
a) North
b) South
c) East
d) West

Answer Key

1-b 2-b 3-d

Day 5 — Solving Seating Arrangements (Review)

Solving Seating Arrangements

For circular arrangements, remember 'left' and 'right' depend on whether people are facing inward or outward — read the question carefully for this detail, as it flips the entire arrangement.

Additional Practice Example: Statement: All squares are rectangles. All rectangles have four sides. Conclusion: All squares have four sides.

Solution: *This is a valid syllogism: since every square is a rectangle (first premise), and every rectangle has four sides (second premise), it necessarily follows that every square has four sides. The conclusion is TRUE and validly follows.*

Day 5 Quiz

1. If A sits immediately to the left of B in a circular arrangement (facing center), and the arrangement is clockwise A,B,C,D, then D is immediately to the ___ of A.

a) Left
b) Right
c) Opposite
d) Cannot be determined

2. In a row of 6, if D is 2nd from the left and F is 2nd from the right, how many people sit strictly between D and F?

a) 1
b) 2
c) 3
d) 4

Answer Key

1-b 2-c

Day 6 — Solving Seating Arrangements (Review)

Solving Seating Arrangements

Worked Example: Five friends sit in a row. A is to the right of B, C is to the left of B. This fixes the order C-B-A for those three; the middle position among these three is B.

Additional Practice Example: Find the odd one out: Kilogram, Litre, Metre, Gram.
Solution: *Kilogram and Gram measure mass, Metre measures length, and Litre measures volume — but if grouping by 'is a mass unit', Litre and Metre are the two non-mass units; the single cleanest classification is that Litre measures volume while the other three (Kilogram, Gram, Metre — though Metre is length) — reconsidering, the cleanest odd-one-out is Litre, since Kilogram and Gram are both mass units and Metre, while a different quantity, is at least a base SI unit like the gram; the most defensible single answer is Litre (the only volume unit).*

Day 6 Quiz

1. In a row of 5 people, if no one is at either end for person X, X could occupy position(s):
a) 1 or 5 only
b) 2, 3, or 4
c) Any position
d) Position 3 only

2. Find the odd one out:
a) January
b) March
c) Tuesday
d) July

Answer Key

1-b 2-c

Week 5 Mock Test

Two short tests to close out Week 5: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 5 Only

1. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?

a) A
b) B
c) C
d) Cannot be determined

2. In a circular arrangement facing the center, 'left' of a person refers to:

a) The clockwise direction
b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

3. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?

a) 3 or 4
b) 2
c) 5
d) 6

4. In seating puzzles, the most useful first step is to:

a) Guess an arrangement randomly
b) Fix the most definite/specific clue first
c) Ignore end-position clues
d) Start from the middle always

5. If A sits immediately to the left of B in a circular arrangement (facing center), and the arrangement is clockwise A,B,C,D, then D is immediately to the ___ of A.

a) Left
b) Right
c) Opposite
d) Cannot be determined

6. In a row of 5 people, if no one is at either end for person X, X could occupy position(s):

a) 1 or 5 only
b) 2, 3, or 4
c) Any position
d) Position 3 only

7. A statement says "M is not at either end." This tells you M is:

a) Definitely in the exact middle
b) Somewhere in the interior positions, exact spot unknown yet
c) At position 1
d) At the last position

8. When solving seating puzzles with multiple clues, contradictory placements indicate:
a) A puzzle typo only
b) You should re-check your earlier deductions for an error
c) The puzzle has multiple valid answers always
d) Nothing significant

9. In a circular table seating problem, how many distinct 'ends' does the table have?
a) 2
b) 1
c) 0
d) 4

10. If clue 1 fixes a person's exact seat and clue 2 only gives a relative position, you should apply:
a) Clue 2 first
b) Clue 1 first, since it's more specific
c) Neither clue
d) Both clues simultaneously without order

11. In a row of 6, if D is 2nd from the left and F is 2nd from the right, how many people sit strictly between D and F?
a) 1
b) 2
c) 3
d) 4

12. Find the odd one out:
a) January
b) March
c) Tuesday
d) July

13. A man starts facing North, turns left twice. He now faces:
a) North
b) South
c) East
d) West

14. In a row of 8, if M is 3rd from the left, what position is M from the right?
a) 3rd
b) 5th
c) 6th
d) 4th

15. Find the odd one out:

a) Monday
b) Wednesday
c) December
d) Friday

16. A man starts facing South, turns right once. He now faces:
a) North
b) South
c) East
d) West

Answer Key

1-b 2-b 3-a 4-b 5-b 6-b 7-b 8-b 9-c 10-b 11-c 12-c 13-b 14-c 15-c 16-d

Part B — Cumulative, Weeks 1-5

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP

c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?
a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?
a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father
b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

13. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?
a) A
b) B
c) C
d) Cannot be determined

14. In a circular arrangement facing the center, 'left' of a person refers to:
a) The clockwise direction

b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

15. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?

a) 3 or 4
b) 2
c) 5
d) 6

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b 10-b 11-a 12-b 13-b 14-b 15-a

Week 6: Logical Puzzles

Use this log to track your Logical Reasoning study sessions for Week 6. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Approaching Logical Puzzles

Approaching Logical Puzzles

Logical puzzles (analogies, odd-one-out, pattern completion with shapes/symbols) test the ability to identify an underlying rule connecting items and apply or extend it. For analogies (A:B :: C:?), first articulate the exact relationship between A and B in words (e.g. 'B is where A works') before searching for the matching relationship in the answer choices.

Additional Practice Example: If facing North-East and you turn 90° clockwise, which direction do you face?

Solution: *Rotating 90° clockwise from North-East lands you on South-East (each 90° clockwise turn moves you two positions around an 8-point compass, or equivalently, directly perpendicular to the original diagonal direction).*

Day 1 Quiz

1. Complete the analogy: Doctor : Hospital :: Teacher : ___
a) Book
b) School
c) Student
d) Chalk

2. Complete the analogy: Author : Book :: Sculptor : ___
a) Chisel
b) Statue
c) Stone
d) Museum

3. If in a code 'PLANT' becomes 'QMBOU' (each letter +1), decode 'UIF'.
a) THE
b) TGE
c) SHE
d) THG

Answer Key

1-b 2-b 3-a

Day 2 — Approaching Logical Puzzles

Approaching Logical Puzzles

For odd-one-out questions, check multiple possible groupings (by category, by property, by count) since more than one 'reasonable' grouping might appear among the options — the correct one is the single most consistent classification covering all-but-one item.

Additional Practice Example: Six friends sit around a circular table facing the center. A is opposite D. B is to the immediate right of A. Where is B relative to D?

Solution: *Since A and D are opposite each other, and B is immediately right of A, B is immediately to the LEFT of D (opposite relationships reverse left/right when moving to the other side of the circle).*

Day 2 Quiz

1. Find the odd one out:

a) Triangle
b) Square
c) Circle
d) Sphere

2. Find the odd one out:

a) Piano
b) Guitar
c) Violin
d) Drum

Answer Key

1-d 2-d

Day 3 — Approaching Logical Puzzles

Approaching Logical Puzzles

Worked Example: Doctor : Hospital :: Teacher : ? — the relationship is 'workplace of.' A teacher's workplace is a School.

Additional Practice Example: Find the next term: 3, 7, 15, 31, ?
Solution: *The pattern is ×2 then +1 each time (3×2+1=7, 7×2+1=15, 15×2+1=31), so the next term is 31×2+1 = 63.*

Day 3 Quiz

1. Complete the analogy: Pen : Write :: Knife : ___
a) Sharp
b) Cut
c) Kitchen
d) Metal

2. Complete the analogy: Kilogram : Weight :: Meter : ___
a) Length
b) Mass
c) Volume
d) Time

Answer Key
1-b 2-a

Day 4 — Approaching Logical Puzzles (Review)

Approaching Logical Puzzles

Logical puzzles (analogies, odd-one-out, pattern completion with shapes/symbols) test the ability to identify an underlying rule connecting items and apply or extend it. For analogies (A:B :: C:?), first articulate the exact relationship between A and B in words (e.g. 'B is where A works') before searching for the matching relationship in the answer choices.

Additional Practice Example: If in a code 'FRIEND' becomes 'EQHDMC' (each letter −1), decode 'DSFBM'.

Solution: *Reverse by adding 1 to each letter: D→E, S→T, F→G, B→C, M→N, giving 'ETGCN' — checking against likely intended word patterns, this shift-back method decodes consistently letter by letter regardless of whether the result forms a common word.*

Day 4 Quiz

1. Find the odd one out:

a) Apple
b) Mango
c) Potato
d) Banana

2. Find the odd one out:

a) Rose
b) Lily
c) Tulip
d) Mango

Answer Key

1-c 2-d

Day 5 — Approaching Logical Puzzles (Review)

Approaching Logical Puzzles

For odd-one-out questions, check multiple possible groupings (by category, by property, by count) since more than one 'reasonable' grouping might appear among the options — the correct one is the single most consistent classification covering all-but-one item.

Additional Practice Example: A is the brother of B. B is the daughter of C. D is C's husband. How is D related to A?

Solution: *C is B's mother, and D is C's husband, so D is B's father. Since A is B's brother, D is also A's father.*

Day 5 Quiz

1. Complete the analogy: Fish : Water :: Bird : ___

a) Nest
b) Air
c) Tree
d) Feather

2. Complete the analogy: Judge : Court :: Referee : ___

a) Whistle
b) Field/pitch
c) Team
d) Rulebook

Answer Key

1-b 2-b

Day 6 — Approaching Logical Puzzles (Review)

Approaching Logical Puzzles

Worked Example: Doctor : Hospital :: Teacher : ? — the relationship is 'workplace of.' A teacher's workplace is a School.

Additional Practice Example: A man walks 10 km north, then 10 km east, then 10 km south. Find his distance and direction from start.

Solution: *The north and south legs (10 km each) cancel out, leaving only the 10 km eastward leg — he is 10 km east of the starting point.*

Day 6 Quiz

1. Find the odd one out:

a) 2
b) 3
c) 9
d) 5

2. Find the next term: 2, 3, 5, 8, 13, ?

a) 18
b) 20
c) 21
d) 24

Answer Key

1-c 2-c

Week 6 Mock Test

Two short tests to close out Week 6: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 6 Only

1. Complete the analogy: Doctor : Hospital :: Teacher : ___
a) Book
b) School
c) Student
d) Chalk

2. Find the odd one out:
a) Triangle
b) Square
c) Circle
d) Sphere

3. Complete the analogy: Pen : Write :: Knife : ___
a) Sharp
b) Cut
c) Kitchen
d) Metal

4. Find the odd one out:
a) Apple
b) Mango
c) Potato
d) Banana

5. Complete the analogy: Fish : Water :: Bird : ___
a) Nest
b) Air
c) Tree
d) Feather

6. Find the odd one out:
a) 2
b) 3
c) 9
d) 5

7. Complete the analogy: Author : Book :: Sculptor : ___
a) Chisel
b) Statue
c) Stone

d) Museum

8. Find the odd one out:
a) Piano
b) Guitar
c) Violin
d) Drum

9. Complete the analogy: Kilogram : Weight :: Meter : ___
a) Length
b) Mass
c) Volume
d) Time

10. Find the odd one out:
a) Rose
b) Lily
c) Tulip
d) Mango

11. Complete the analogy: Judge : Court :: Referee : ___
a) Whistle
b) Field/pitch
c) Team
d) Rulebook

12. Find the next term: 2, 3, 5, 8, 13, ?
a) 18
b) 20
c) 21
d) 24

13. If in a code 'PLANT' becomes 'QMBOU' (each letter +1), decode 'UIF'.
a) THE
b) TGE
c) SHE
d) THG

Answer Key

1-b 2-d 3-b 4-c 5-b 6-c 7-b 8-d 9-a 10-d 11-b 12-c 13-a

Part B — Cumulative, Weeks 1-6

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?

a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
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b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?
a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?
a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father
b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?

a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

13. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?
a) A
b) B
c) C
d) Cannot be determined

14. In a circular arrangement facing the center, 'left' of a person refers to:
a) The clockwise direction
b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

15. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?
a) 3 or 4
b) 2
c) 5
d) 6

16. Complete the analogy: Doctor : Hospital :: Teacher : ___
a) Book
b) School
c) Student
d) Chalk

17. Find the odd one out:
a) Triangle
b) Square
c) Circle
d) Sphere

18. Complete the analogy: Pen : Write :: Knife : ___

a) Sharp
b) Cut
c) Kitchen
d) Metal

Answer Key

1-c	*2-b*	*3-b*	*4-a*	*5-a*	*6-a*	*7-a*	*8-b*	*9-b*	*10-b*	*11-a*	*12-b*	*13-b*	*14-b*	*15-a*	*16-b*	*17-d*	*18-b*

Week 7: Mixed Reasoning

Use this log to track your Logical Reasoning study sessions for Week 7. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Combining Reasoning Skills

Combining Reasoning Skills

This week, practice number series, coding-decoding, and blood relations together in randomized order — the real exam won't group question types by topic, so building the ability to quickly identify 'what kind of question is this' is itself a trainable skill.

Additional Practice Example: Complete the analogy: Author : Manuscript :: Composer : ___
Solution: *Following 'creator : their created work', a Composer creates a Symphony (or musical Score).*

Day 1 Quiz

1. Find the next number: 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

2. If 'LION' is coded as 'MJPO', what rule is applied?
a) Each letter shifted +1
b) Each letter shifted -1
c) Letters reversed
d) Letters doubled

3. Find the odd one out:
a) Lion
b) Tiger
c) Leopard
d) Eagle

Answer Key
1-b 2-a 3-d

Day 2 — Combining Reasoning Skills

Combining Reasoning Skills

A useful habit: spend the first 3-5 seconds of any reasoning question simply classifying it (series? coding? relation? direction?) before attempting to solve — this prevents wasted time applying the wrong technique.

Additional Practice Example: Statement: No cats are dogs. All dogs are animals. Conclusion: No cats are animals. Is this valid?

Solution: *This conclusion is INVALID. The premises only tell us cats aren't dogs and dogs are animals — they say nothing preventing cats from also being animals (which, in reality, they are). The conclusion does not follow.*

Day 2 Quiz

1. If in a code 'TEA' is written as 'UFB' (each letter +1), how is 'CUP' written?

a) DVQ
b) DVR
c) CVQ
d) DWQ

2. P is the son of Q. Q is the sister of R. How is R related to P?

a) Uncle/Aunt
b) Father
c) Brother
d) Grandfather

Answer Key

1-a 2-a

Day 3 — Combining Reasoning Skills (Review)

Combining Reasoning Skills

This week, practice number series, coding-decoding, and blood relations together in randomized order — the real exam won't group question types by topic, so building the ability to quickly identify 'what kind of question is this' is itself a trainable skill.

Additional Practice Example: In a row of 7 people, P is 3rd from the left and 3rd from the right. Is this possible, and what does it imply?

Solution: *For a row of 7, being 3rd from the left means position 3, and 3rd from the right in a 7-person row also means position 5 (7−3+1=5) — these do not match, so this scenario is impossible unless P is exactly in the middle (position 4) of an odd-length row of 7, which would make P 4th from both ends, not 3rd — so the given condition is inconsistent for a row of exactly 7.*

Day 3 Quiz

1. A is B's daughter. C is A's brother. What is C to B?

a) Son
b) Father
c) Nephew
d) Brother

2. Facing East and turning 90° clockwise twice, you now face:

a) East
b) West
c) North
d) South

Answer Key

1-a 2-b

Day 4 — Combining Reasoning Skills (Review)

Combining Reasoning Skills

A useful habit: spend the first 3-5 seconds of any reasoning question simply classifying it (series? coding? relation? direction?) before attempting to solve — this prevents wasted time applying the wrong technique.

Additional Practice Example: Find the odd one out: Square, Cube, Rectangle, Circle.
Solution: *Cube is a 3-dimensional solid, while Square, Rectangle, and Circle are all 2-dimensional shapes — Cube is the odd one out.*

Day 4 Quiz

1. A man walks 3 km east, then 4 km north. How far is he from his start?
a) 5 km
b) 7 km
c) 1 km
d) 12 km

2. Complete the analogy: Key : Lock :: Password : ___
a) Computer
b) Account
c) Security
d) Login

Answer Key

1-a 2-b

Day 5 — Combining Reasoning Skills (Review)

Combining Reasoning Skills

This week, practice number series, coding-decoding, and blood relations together in randomized order — the real exam won't group question types by topic, so building the ability to quickly identify 'what kind of question is this' is itself a trainable skill.

Additional Practice Example: A is North of B. C is East of B. What direction is C from A?
Solution: *Since C is east of B, and A is directly north of B, C is South-East of A.*

Day 5 Quiz

1. Find the odd one out:
a) Square
b) Rectangle
c) Cube
d) Rhombus

2. Statement: All swimmers are athletes. No athlete is lazy. Conclusion: No swimmer is lazy. This is:
a) True and validly follows
b) False
c) Cannot be determined
d) Irrelevant

Answer Key

1-c 2-a

Day 6 — Combining Reasoning Skills (Review)

Combining Reasoning Skills

A useful habit: spend the first 3-5 seconds of any reasoning question simply classifying it (series? coding? relation? direction?) before attempting to solve — this prevents wasted time applying the wrong technique.

Additional Practice Example: Complete the series: J, F, M, A, M, ? (first letters of months)
Solution: *January, February, March, April, May, so next is June: J.*

Day 6 Quiz

1. Complete the series: 5, 11, 23, 47, ?
a) 94
b) 95
c) 96
d) 93

2. A is taller than B. C is shorter than B. Who is the tallest?
a) A
b) B
c) C
d) Cannot be determined

Answer Key

1-b 2-a

Week 7 Mock Test

Two short tests to close out Week 7: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 7 Only

1. Find the next number: 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

2. If in a code 'TEA' is written as 'UFB' (each letter +1), how is 'CUP' written?
a) DVQ
b) DVR
c) CVQ
d) DWQ

3. A is B's daughter. C is A's brother. What is C to B?
a) Son
b) Father
c) Nephew
d) Brother

4. A man walks 3 km east, then 4 km north. How far is he from his start?
a) 5 km
b) 7 km
c) 1 km
d) 12 km

5. Find the odd one out:
a) Square
b) Rectangle
c) Cube
d) Rhombus

6. Complete the series: 5, 11, 23, 47, ?
a) 94
b) 95
c) 96
d) 93

7. If 'LION' is coded as 'MJPO', what rule is applied?
a) Each letter shifted +1
b) Each letter shifted -1
c) Letters reversed

d) Letters doubled

8. P is the son of Q. Q is the sister of R. How is R related to P?
a) Uncle/Aunt
b) Father
c) Brother
d) Grandfather

9. Facing East and turning 90° clockwise twice, you now face:
a) East
b) West
c) North
d) South

10. Complete the analogy: Key : Lock :: Password : ___
a) Computer
b) Account
c) Security
d) Login

11. Statement: All swimmers are athletes. No athlete is lazy. Conclusion: No swimmer is lazy. This is:
a) True and validly follows
b) False
c) Cannot be determined
d) Irrelevant

12. A is taller than B. C is shorter than B. Who is the tallest?
a) A
b) B
c) C
d) Cannot be determined

13. Find the odd one out:
a) Lion
b) Tiger
c) Leopard
d) Eagle

Answer Key

1-b 2-a 3-a 4-a 5-c 6-b 7-a 8-a 9-b 10-b 11-a 12-a 13-d

Part B — Cumulative, Weeks 1-7

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?

a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?

a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:

a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?

a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?

a) NPPO
b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?

a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?

a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?

a) Father
b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

13. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?
a) A
b) B
c) C
d) Cannot be determined

14. In a circular arrangement facing the center, 'left' of a person refers to:
a) The clockwise direction
b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

15. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?
a) 3 or 4
b) 2
c) 5
d) 6

16. Complete the analogy: Doctor : Hospital :: Teacher : ___
a) Book
b) School
c) Student
d) Chalk

17. Find the odd one out:
a) Triangle
b) Square
c) Circle
d) Sphere

18. Complete the analogy: Pen : Write :: Knife : ___
a) Sharp
b) Cut
c) Kitchen
d) Metal

19. Find the next number: 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

20. If in a code 'TEA' is written as 'UFB' (each letter +1), how is 'CUP' written?
a) DVQ
b) DVR
c) CVQ
d) DWQ

21. A is B's daughter. C is A's brother. What is C to B?
a) Son
b) Father
c) Nephew
d) Brother

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b 10-b 11-a 12-b 13-b 14-b 15-a 16-b 17-d 18-b 19-b 20-a 21-a

Week 8: Analytical Reasoning

Use this log to track your Logical Reasoning study sessions for Week 8. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Syllogisms and Statement-Conclusion Analysis

Syllogisms and Statement-Conclusion Analysis

Analytical/critical reasoning questions give one or more statements and ask which conclusions logically follow. A conclusion 'follows' only if it is a necessary logical consequence of the statement(s) — not merely plausible or commonly true in the real world.

Additional Practice Example: Statement: Some cats are black. All black things absorb heat. Conclusion: Some cats absorb heat. Is this valid?

Solution: *Yes, this is valid: since some cats are (in the category of) black things, and all black things absorb heat, those specific cats must absorb heat.*

Day 1 Quiz

1. Statement: All roses are flowers. Some flowers fade quickly. Conclusion: Some roses fade quickly. This conclusion is:

a) True
b) False
c) Cannot be determined
d) None of these

2. If a syllogism's premises are true but the stated conclusion could still be false in some valid scenario, the conclusion:

a) Follows
b) Does not follow
c) Is always true
d) Is irrelevant

3. P is Q's daughter. Q is R's wife. How is R related to P?

a) Father
b) Uncle
c) Brother
d) Grandfather

Answer Key

1-c 2-b 3-a

Day 2 — Syllogisms and Statement-Conclusion Analysis

Syllogisms and Statement-Conclusion Analysis

Classic syllogism trap: 'All roses are flowers. Some flowers fade quickly.' does NOT let you conclude 'Some roses fade quickly' — the 'some flowers' that fade quickly might not include any roses at all. Only conclusions that must be true in every possible scenario consistent with the statements are valid.

Additional Practice Example: If in a code 'RIVER' becomes 'SJWFS' (each letter +1), what does 'OCEAN' become?
Solution: *Shift each letter forward by 1: O→P, C→D, E→F, A→B, N→O, giving 'PDFBO'.*

Day 2 Quiz

1. Statement: No new tax has been proposed. It is still a surplus budget. Conclusion I: The budget may be considered good. Conclusion II: It is a surplus budget because no new tax was proposed. Which follows?

a) Only conclusion II
b) Only conclusion I
c) Both I and II
d) Neither I nor II

2. Fact 1: Most stuffed toys are stuffed with beans. Fact 2: There are stuffed bears and tigers. Fact 3: Some chairs are stuffed with beans. Which must be a fact? I. Only children's chairs are stuffed with beans. II. All stuffed tigers are stuffed with beans. III. Stuffed monkeys are not stuffed with beans.

a) I only
b) II only
c) II and III only
d) None of the statements is true

Answer Key

1-a 2-d

Day 3 — Syllogisms and Statement-Conclusion Analysis

Syllogisms and Statement-Conclusion Analysis

For 'Statement + Conclusion I/II' format questions: test each conclusion independently against the statement, asking 'could this be false while the statement stays true?' — if yes, that conclusion does not follow.

Additional Practice Example: Find the next term: 2, 5, 10, 17, 26, ?

Solution: *The differences are 3, 5, 7, 9 (increasing odd numbers). The next difference should be 11, giving 26+11 = 37.*

Day 3 Quiz

1. Fact 1: All chickens are birds. Fact 2: Some chickens are hens. Fact 3: Female birds lay eggs. Which must also be true? I. All birds lay eggs. II. Hens are birds. III. Some chickens are not hens.

a) II only
b) II and III only
c) I, II, and III
d) None of the statements is true

2. In statement-conclusion questions, 'cannot be determined' is the correct choice when:

a) Both conclusions clearly follow
b) Neither conclusion is even plausible
c) The conclusion could be true or false depending on unstated facts
d) The statement is grammatically incorrect

Answer Key

1-a 2-c

Day 4 — Syllogisms and Statement-Conclusion Analysis (Review)

Syllogisms and Statement-Conclusion Analysis

Analytical/critical reasoning questions give one or more statements and ask which conclusions logically follow. A conclusion 'follows' only if it is a necessary logical consequence of the statement(s) — not merely plausible or commonly true in the real world.

Additional Practice Example: If in a code 'GARDEN' is written as 'HBSEFO' (each letter +1), decode 'IFMMP'.

Solution: *Reverse the shift by subtracting 1 from each letter: I→H, F→E, M→L, M→L, P→O, giving 'HELLO'.*

Day 4 Quiz

1. A conclusion 'follows' from a statement only if it is:
a) Commonly believed to be true
b) A necessary logical consequence of the statement
c) Plausible in most cases
d) Supported by outside knowledge

2. A well-constructed syllogism conclusion must hold:
a) In most typical cases
b) In at least one possible scenario
c) In every possible scenario consistent with the premises
d) Only if common sense agrees

Answer Key

1-b 2-c

Day 5 — Syllogisms and Statement-Conclusion Analysis (Review)

Syllogisms and Statement-Conclusion Analysis

Classic syllogism trap: 'All roses are flowers. Some flowers fade quickly.' does NOT let you conclude 'Some roses fade quickly' — the 'some flowers' that fade quickly might not include any roses at all. Only conclusions that must be true in every possible scenario consistent with the statements are valid.

Additional Practice Example: A is B's mother. C is B's son. What is A to C?
Solution: *A is B's mother, and C is B's son (so B is C's parent). A is therefore the grandmother of C.*

Day 5 Quiz

1. Statement: Apart from education, newspapers' recreational value should be considered. Conclusion I: People read newspapers only for education. Conclusion II: Entertainment value of newspapers is also important. Which follows?

a) Only conclusion I
b) Only conclusion II
c) Both I and II
d) Neither

2. A cube's total number of edges is:

a) 6
b) 8
c) 12
d) 4

Answer Key

1-b 2-c

Day 6 — Syllogisms and Statement-Conclusion Analysis (Review)

Syllogisms and Statement-Conclusion Analysis

For 'Statement + Conclusion I/II' format questions: test each conclusion independently against the statement, asking 'could this be false while the statement stays true?' — if yes, that conclusion does not follow.

Additional Practice Example: A man walks 6 km east, turns right, walks 4 km, turns right again, walks 6 km. How far is he from his start, and in what direction?

Solution: *East 6 km (facing East), turn right → facing South, walk 4 km. Turn right again → facing West, walk 6 km. The eastward and westward legs (6 km each) cancel out entirely, leaving only the 4 km southward leg — he is 4 km south (in the south direction) of the start.*

Day 6 Quiz

1. Which of the following is NOT a useful principle for making scientific/logical progress?
a) Similar effects likely have similar causes
b) Look only for confirming instances, never disconfirming ones
c) Look for the key relevant difference between situations
d) Divide the problem into manageable components

2. Complete the series: 1, 8, 27, 64, ? (cubes)
a) 100
b) 125
c) 121
d) 81

Answer Key

1-b 2-b

Week 8 Mock Test

Two short tests to close out Week 8: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 8 Only

1. Statement: All roses are flowers. Some flowers fade quickly. Conclusion: Some roses fade quickly. This conclusion is:

a) True
b) False
c) Cannot be determined
d) None of these

2. Statement: No new tax has been proposed. It is still a surplus budget. Conclusion I: The budget may be considered good. Conclusion II: It is a surplus budget because no new tax was proposed. Which follows?

a) Only conclusion II
b) Only conclusion I
c) Both I and II
d) Neither I nor II

3. Fact 1: All chickens are birds. Fact 2: Some chickens are hens. Fact 3: Female birds lay eggs. Which must also be true? I. All birds lay eggs. II. Hens are birds. III. Some chickens are not hens.

a) II only
b) II and III only
c) I, II, and III
d) None of the statements is true

4. A conclusion 'follows' from a statement only if it is:

a) Commonly believed to be true
b) A necessary logical consequence of the statement
c) Plausible in most cases
d) Supported by outside knowledge

5. Statement: Apart from education, newspapers' recreational value should be considered. Conclusion I: People read newspapers only for education. Conclusion II: Entertainment value of newspapers is also important. Which follows?

a) Only conclusion I
b) Only conclusion II
c) Both I and II
d) Neither

6. Which of the following is NOT a useful principle for making scientific/logical progress?

a) Similar effects likely have similar causes
b) Look only for confirming instances, never disconfirming ones
c) Look for the key relevant difference between situations

d) Divide the problem into manageable components

7. If a syllogism's premises are true but the stated conclusion could still be false in some valid scenario, the conclusion:

a) Follows
b) Does not follow
c) Is always true
d) Is irrelevant

8. Fact 1: Most stuffed toys are stuffed with beans. Fact 2: There are stuffed bears and tigers. Fact 3: Some chairs are stuffed with beans. Which must be a fact? I. Only children's chairs are stuffed with beans. II. All stuffed tigers are stuffed with beans. III. Stuffed monkeys are not stuffed with beans.

a) I only
b) II only
c) II and III only
d) None of the statements is true

9. In statement-conclusion questions, 'cannot be determined' is the correct choice when:

a) Both conclusions clearly follow
b) Neither conclusion is even plausible
c) The conclusion could be true or false depending on unstated facts
d) The statement is grammatically incorrect

10. A well-constructed syllogism conclusion must hold:

a) In most typical cases
b) In at least one possible scenario
c) In every possible scenario consistent with the premises
d) Only if common sense agrees

11. A cube's total number of edges is:

a) 6
b) 8
c) 12
d) 4

12. Complete the series: 1, 8, 27, 64, ? (cubes)

a) 100
b) 125
c) 121
d) 81

13. P is Q's daughter. Q is R's wife. How is R related to P?

a) Father
b) Uncle
c) Brother
d) Grandfather

Answer Key

1-c 2-a 3-a 4-b 5-b 6-b 7-b 8-d 9-c 10-c 11-c 12-b 13-a

Part B — Cumulative, Weeks 1-8

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?
a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?
a) Mother
b) Aunt
c) Sister

d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father
b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

13. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?
a) A
b) B
c) C
d) Cannot be determined

14. In a circular arrangement facing the center, 'left' of a person refers to:
a) The clockwise direction
b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

15. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?
a) 3 or 4
b) 2
c) 5
d) 6

16. Complete the analogy: Doctor : Hospital :: Teacher : ___
a) Book
b) School

c) Student
d) Chalk

17. Find the odd one out:
a) Triangle
b) Square
c) Circle
d) Sphere

18. Complete the analogy: Pen : Write :: Knife : ___
a) Sharp
b) Cut
c) Kitchen
d) Metal

19. Find the next number: 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

20. If in a code 'TEA' is written as 'UFB' (each letter +1), how is 'CUP' written?
a) DVQ
b) DVR
c) CVQ
d) DWQ

21. A is B's daughter. C is A's brother. What is C to B?
a) Son
b) Father
c) Nephew
d) Brother

22. Statement: All roses are flowers. Some flowers fade quickly. Conclusion: Some roses fade quickly. This conclusion is:
a) True
b) False
c) Cannot be determined
d) None of these

23. Statement: No new tax has been proposed. It is still a surplus budget. Conclusion I: The budget may be considered good. Conclusion II: It is a surplus budget because no new tax was proposed. Which follows?
a) Only conclusion II
b) Only conclusion I
c) Both I and II
d) Neither I nor II

24. Fact 1: All chickens are birds. Fact 2: Some chickens are hens. Fact 3: Female birds lay eggs. Which must also be true? I. All birds lay eggs. II. Hens are birds. III. Some chickens are not hens.

a) II only
b) II and III only
c) I, II, and III
d) None of the statements is true

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b 10-b 11-a 12-b 13-b 14-b 15-a 16-b 17-d 18-b 19-b 20-a 21-a 22-c 23-a 24-a

Week 9: Mixed MCQs — Full Reasoning Review

Use this log to track your Logical Reasoning study sessions for Week 9. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Comprehensive Reasoning Review

Comprehensive Reasoning Review

This week's practice draws from every reasoning sub-type covered so far, at a volume and randomness matching the real 15-question Logical Reasoning section. Also practice statement-based critical reasoning items that test careful reading rather than pattern-spotting — e.g. identifying whether a sentence is a claim/statement at all, or spotting an unintentionally funny/ambiguous headline and choosing the intended rewrite.

Additional Practice Example: Five people P,Q,R,S,T sit in a row. Q is second from the left. P is immediately right of Q. T is at the right end. Where can R and S sit?
Solution: *Positions 1-5 from left. Q is at position 2. P is at position 3 (immediately right of Q). T is at position 5. That leaves positions 1 and 4 for R and S in some order — the exact assignment needs an additional clue to fully resolve, but both must occupy positions 1 and 4.*

Day 1 Quiz

1. Which sentence below probably is NOT being used to make a claim (a statement)?
a) Financial ruin from medical bills is common in some countries
b) I wonder if we should turn back
c) I learned that minor surgery means someone else is operated on
d) My bumper sticker asks about love at first sight

2. Reading carefully for what is literally claimed (vs. implied) is most important in:
a) Number series
b) Statement-based critical reasoning
c) Seating arrangement
d) Direction sense

3. A person moves 4 km east, 4 km north, 4 km west. Their distance from start is:
a) 0 km
b) 4 km
c) 8 km
d) 12 km

Answer Key

1-b 2-b 3-b

Day 2 — Comprehensive Reasoning Review

Comprehensive Reasoning Review

Worked Example: A headline reads 'New Pill Controls Birth Twice a Month' — ambiguous because it could mean the pill is taken twice a month, not that it controls birth twice a month. The intended rewrite clarifies the pill's usage frequency, not the frequency of the biological event.

Additional Practice Example: Complete the analogy: Ounce : Weight :: Litre : ___
Solution: *Following the pattern 'unit : quantity it measures', Litre measures Volume.*

Day 2 Quiz

1. If a headline says "New Pill Controls Birth Twice a Month," the most likely INTENDED meaning is:

a) The pill controls pregnancy twice a month
b) The new pill can be taken twice a month to control pregnancy
c) Taking the pill twice a month promotes birth
d) None of these

2. A sentence phrased as a question ("I wonder if...") is usually:

a) A strong claim
b) Not a claim/statement
c) Always false
d) A syllogism

Answer Key

1-b 2-b

Day 3 — Comprehensive Reasoning Review (Review)

Comprehensive Reasoning Review

This week's practice draws from every reasoning sub-type covered so far, at a volume and randomness matching the real 15-question Logical Reasoning section. Also practice statement-based critical reasoning items that test careful reading rather than pattern-spotting — e.g. identifying whether a sentence is a claim/statement at all, or spotting an unintentionally funny/ambiguous headline and choosing the intended rewrite.

Additional Practice Example: Statement: All squares are rectangles. All rectangles have four sides. Conclusion: All squares have four sides.

Solution: *This is a valid syllogism: since every square is a rectangle (first premise), and every rectangle has four sides (second premise), it necessarily follows that every square has four sides. The conclusion is TRUE and validly follows.*

Day 3 Quiz

1. What is the conclusion indicator in: "If it rains, it's a bad day for a picnic. So, we shouldn't go, since Svetlana heard it's raining."

a) Then
b) At least
c) So
d) No conclusion

2. In mixed reasoning practice, the best time-saving habit is to:

a) Solve every question in the order given, no matter what
b) Quickly classify the question type before solving
c) Skip all series questions
d) Only attempt questions with pictures

Answer Key

1-c 2-b

Day 4 — Comprehensive Reasoning Review (Review)

Comprehensive Reasoning Review

Worked Example: A headline reads 'New Pill Controls Birth Twice a Month' — ambiguous because it could mean the pill is taken twice a month, not that it controls birth twice a month. The intended rewrite clarifies the pill's usage frequency, not the frequency of the biological event.

Additional Practice Example: Find the odd one out: Kilogram, Litre, Metre, Gram.
Solution: *Kilogram and Gram measure mass, Metre measures length, and Litre measures volume — but if grouping by 'is a mass unit', Litre and Metre are the two non-mass units; the single cleanest classification is that Litre measures volume while the other three (Kilogram, Gram, Metre — though Metre is length) — reconsidering, the cleanest odd-one-out is Litre, since Kilogram and Gram are both mass units and Metre, while a different quantity, is at least a base SI unit like the gram; the most defensible single answer is Litre (the only volume unit).*

Day 4 Quiz

1. Fill the blank pattern: QAR RAS SAT TAU _____
a) UAV
b) UAT
c) TAS
d) TAT

2. For ambiguous headline rewrite questions, the correct choice is the one that:
a) Preserves the ambiguity
b) Reflects the most probable intended meaning
c) Is the shortest option
d) Uses the most technical language

Answer Key

1-a 2-b

Day 5 — Comprehensive Reasoning Review (Review)

Comprehensive Reasoning Review

This week's practice draws from every reasoning sub-type covered so far, at a volume and randomness matching the real 15-question Logical Reasoning section. Also practice statement-based critical reasoning items that test careful reading rather than pattern-spotting — e.g. identifying whether a sentence is a claim/statement at all, or spotting an unintentionally funny/ambiguous headline and choosing the intended rewrite.

Additional Practice Example: If facing North-East and you turn 90° clockwise, which direction do you face?
Solution: *Rotating 90° clockwise from North-East lands you on South-East (each 90° clockwise turn moves you two positions around an 8-point compass, or equivalently, directly perpendicular to the original diagonal direction).*

Day 5 Quiz

1. Four witnesses described a mugger differently. Which description is most likely correct, if three broadly agree on 'tall' and 'thin'?
a) Average height, thin, middle-aged
b) Tall, thin, middle-aged
c) Tall, thin, young
d) Tall, average weight, middle-aged

2. In a family tree, if X is Y's paternal grandmother, X is the mother of Y's:
a) Mother
b) Father
c) Sister
d) Aunt

Answer Key
1-b 2-b

Day 6 — Comprehensive Reasoning Review (Review)

Comprehensive Reasoning Review

Worked Example: A headline reads 'New Pill Controls Birth Twice a Month' — ambiguous because it could mean the pill is taken twice a month, not that it controls birth twice a month. The intended rewrite clarifies the pill's usage frequency, not the frequency of the biological event.

Additional Practice Example: Six friends sit around a circular table facing the center. A is opposite D. B is to the immediate right of A. Where is B relative to D?

Solution: *Since A and D are opposite each other, and B is immediately right of A, B is immediately to the LEFT of D (opposite relationships reverse left/right when moving to the other side of the circle).*

Day 6 Quiz

1. In a made-up language: plekapaki=fruitcake, pakishillen=cakewalk, treftalan=buttercup. Which word could mean "cupcake"?

a) alanpaki
b) shillenalan
c) treftpleka
d) pakitreft

2. Find the next term: 90, 80, 71, 63, ?

a) 55
b) 56
c) 57
d) 58

Answer Key

1-d 2-c

Week 9 Mock Test

Two short tests to close out Week 9: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 9 Only

1. Which sentence below probably is NOT being used to make a claim (a statement)?
a) Financial ruin from medical bills is common in some countries
b) I wonder if we should turn back
c) I learned that minor surgery means someone else is operated on
d) My bumper sticker asks about love at first sight

2. If a headline says "New Pill Controls Birth Twice a Month," the most likely INTENDED meaning is:
a) The pill controls pregnancy twice a month
b) The new pill can be taken twice a month to control pregnancy
c) Taking the pill twice a month promotes birth
d) None of these

3. What is the conclusion indicator in: "If it rains, it's a bad day for a picnic. So, we shouldn't go, since Svetlana heard it's raining."
a) Then
b) At least
c) So
d) No conclusion

4. Fill the blank pattern: QAR RAS SAT TAU _____
a) UAV
b) UAT
c) TAS
d) TAT

5. Four witnesses described a mugger differently. Which description is most likely correct, if three broadly agree on 'tall' and 'thin'?
a) Average height, thin, middle-aged
b) Tall, thin, middle-aged
c) Tall, thin, young
d) Tall, average weight, middle-aged

6. In a made-up language: plekapaki=fruitcake, pakishillen=cakewalk, treftalan=buttercup. Which word could mean "cupcake"?
a) alanpaki
b) shillenalan
c) treftpleka
d) pakitreft

7. Reading carefully for what is literally claimed (vs. implied) is most important in:
a) Number series
b) Statement-based critical reasoning
c) Seating arrangement
d) Direction sense

8. A sentence phrased as a question ("I wonder if...") is usually:
a) A strong claim
b) Not a claim/statement
c) Always false
d) A syllogism

9. In mixed reasoning practice, the best time-saving habit is to:
a) Solve every question in the order given, no matter what
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c) Skip all series questions
d) Only attempt questions with pictures

10. For ambiguous headline rewrite questions, the correct choice is the one that:
a) Preserves the ambiguity
b) Reflects the most probable intended meaning
c) Is the shortest option
d) Uses the most technical language

11. In a family tree, if X is Y's paternal grandmother, X is the mother of Y's:
a) Mother
b) Father
c) Sister
d) Aunt

12. Find the next term: 90, 80, 71, 63, ?
a) 55
b) 56
c) 57
d) 58

13. A person moves 4 km east, 4 km north, 4 km west. Their distance from start is:
a) 0 km
b) 4 km
c) 8 km
d) 12 km

Answer Key

1-b 2-b 3-c 4-a 5-b 6-d 7-b 8-b 9-b 10-b 11-b 12-c 13-b

Part B — Cumulative, Weeks 1-9

1. Find the next number: 2, 4, 8, 16, __
a) 18

b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH
d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?
a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?
a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father

b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South
d) North

13. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?
a) A
b) B
c) C
d) Cannot be determined

14. In a circular arrangement facing the center, 'left' of a person refers to:
a) The clockwise direction
b) The counter-clockwise direction
c) Directly opposite
d) Cannot be determined without more info

15. Six people sit in a row. P is at one end. Q is second from the other end. If R sits exactly in the middle, which seat number is R in (1-6, P is seat 1)?
a) 3 or 4
b) 2
c) 5
d) 6

16. Complete the analogy: Doctor : Hospital :: Teacher : ___
a) Book
b) School
c) Student
d) Chalk

17. Find the odd one out:

a) Triangle
b) Square
c) Circle
d) Sphere

18. Complete the analogy: Pen : Write :: Knife : ___
a) Sharp
b) Cut
c) Kitchen
d) Metal

19. Find the next number: 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

20. If in a code 'TEA' is written as 'UFB' (each letter +1), how is 'CUP' written?
a) DVQ
b) DVR
c) CVQ
d) DWQ

21. A is B's daughter. C is A's brother. What is C to B?
a) Son
b) Father
c) Nephew
d) Brother

22. Statement: All roses are flowers. Some flowers fade quickly. Conclusion: Some roses fade quickly. This conclusion is:
a) True
b) False
c) Cannot be determined
d) None of these

23. Statement: No new tax has been proposed. It is still a surplus budget. Conclusion I: The budget may be considered good. Conclusion II: It is a surplus budget because no new tax was proposed. Which follows?
a) Only conclusion II
b) Only conclusion I
c) Both I and II
d) Neither I nor II

24. Fact 1: All chickens are birds. Fact 2: Some chickens are hens. Fact 3: Female birds lay eggs. Which must also be true? I. All birds lay eggs. II. Hens are birds. III. Some chickens are not hens.
a) II only
b) II and III only
c) I, II, and III

d) None of the statements is true

25. Which sentence below probably is NOT being used to make a claim (a statement)?

a) Financial ruin from medical bills is common in some countries
b) I wonder if we should turn back
c) I learned that minor surgery means someone else is operated on
d) My bumper sticker asks about love at first sight

26. If a headline says "New Pill Controls Birth Twice a Month," the most likely INTENDED meaning is:

a) The pill controls pregnancy twice a month
b) The new pill can be taken twice a month to control pregnancy
c) Taking the pill twice a month promotes birth
d) None of these

27. What is the conclusion indicator in: "If it rains, it's a bad day for a picnic. So, we shouldn't go, since Svetlana heard it's raining."

a) Then
b) At least
c) So
d) No conclusion

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b 10-b 11-a 12-b 13-b 14-b 15-a 16-b 17-d 18-b 19-b 20-a 21-a 22-c 23-a 24-a 25-b 26-b 27-c

Week 10: Full Practice — All Reasoning Topics

Use this log to track your Logical Reasoning study sessions for Week 10. Fill in the date, how long you studied, your quiz score for the day, and one honest note about what felt hardest — this running record is what makes your Sunday review sessions (Part 6) targeted instead of a guess.

Day	Date	Time Spent	Quiz Score	Hardest Topic Today
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Day 1 — Final Mixed Practice Set

Final Mixed Practice Set

A last full-topic sweep before moving into general revision weeks — mix in a couple of visual/symbol-pattern items alongside the verbal reasoning types, since the real exam occasionally uses a small figure/symbol sequence question.

Additional Practice Example: Find the next term: 3, 7, 15, 31, ?
Solution: *The pattern is ×2 then +1 each time (3×2+1=7, 7×2+1=15, 15×2+1=31), so the next term is 31×2+1 = 63.*

Day 1 Quiz

1. Find the next number: 6, 13, 27, 55, ?
a) 110
b) 111
c) 112
d) 109

2. Complete the analogy: Thermometer : Temperature :: Speedometer : ___
a) Distance
b) Speed
c) Time
d) Fuel

Answer Key

1-b 2-b

Day 2 — Final Mixed Practice Set (Review)

Final Mixed Practice Set

A last full-topic sweep before moving into general revision weeks — mix in a couple of visual/symbol-pattern items alongside the verbal reasoning types, since the real exam occasionally uses a small figure/symbol sequence question.

Additional Practice Example: If in a code 'FRIEND' becomes 'EQHDMC' (each letter −1), decode 'DSFBM'.

Solution: *Reverse by adding 1 to each letter: D→E, S→T, F→G, B→C, M→N, giving 'ETGCN' — checking against likely intended word patterns, this shift-back method decodes consistently letter by letter regardless of whether the result forms a common word.*

Day 2 Quiz

1. If 'MOUSE' is coded with each letter shifted +1, what is the code?

a) NPVTF
b) NPUTF
c) NPVTG
d) MPVTF

2. Statement: All engineers are logical. Some logical people are also creative. Conclusion: Some engineers are creative. This is:

a) True
b) False
c) Cannot be determined
d) Always false

Answer Key

1-a 2-c

Day 3 — Final Mixed Practice Set (Review)

Final Mixed Practice Set

A last full-topic sweep before moving into general revision weeks — mix in a couple of visual/symbol-pattern items alongside the verbal reasoning types, since the real exam occasionally uses a small figure/symbol sequence question.

Additional Practice Example: A is the brother of B. B is the daughter of C. D is C's husband. How is D related to A?

Solution: *C is B's mother, and D is C's husband, so D is B's father. Since A is B's brother, D is also A's father.*

Day 3 Quiz

1. X is Y's father. Z is X's mother. How is Z related to Y?

a) Mother
b) Grandmother
c) Aunt
d) Sister

2. Facing North and making three consecutive 90° right turns, you now face:

a) North
b) South
c) East
d) West

Answer Key

1-b 2-d

Day 4 — Final Mixed Practice Set (Review)

Final Mixed Practice Set

A last full-topic sweep before moving into general revision weeks — mix in a couple of visual/symbol-pattern items alongside the verbal reasoning types, since the real exam occasionally uses a small figure/symbol sequence question.

Additional Practice Example: A man walks 10 km north, then 10 km east, then 10 km south. Find his distance and direction from start.

Solution: *The north and south legs (10 km each) cancel out, leaving only the 10 km eastward leg — he is 10 km east of the starting point.*

Day 4 Quiz

1. A man walks 8 km north, then 6 km east. His distance from the start is:
a) 10 km
b) 14 km
c) 2 km
d) 48 km

2. In a made-up code, if the whole alphabet is reversed (A=Z,B=Y,...), what does 'ZEBRA' become?
a) AVYIZ
b) AVYZI
c) AVIZY
d) AYVZI

Answer Key

1-a 2-a

Day 5 — Final Mixed Practice Set (Review)

Final Mixed Practice Set

A last full-topic sweep before moving into general revision weeks — mix in a couple of visual/symbol-pattern items alongside the verbal reasoning types, since the real exam occasionally uses a small figure/symbol sequence question.

Additional Practice Example: Complete the analogy: Author : Manuscript :: Composer : ___
Solution: *Following 'creator : their created work', a Composer creates a Symphony (or musical Score).*

Day 5 Quiz

1. Six people sit around a circular table facing the center. If clue conflicts arise while solving, you should:

a) Ignore the conflicting clue
b) Recheck earlier deductions for an error
c) Assume multiple correct answers exist
d) Restart with a guess

Answer Key

1-b

Day 6 — Final Mixed Practice Set (Review)

Final Mixed Practice Set

A last full-topic sweep before moving into general revision weeks — mix in a couple of visual/symbol-pattern items alongside the verbal reasoning types, since the real exam occasionally uses a small figure/symbol sequence question.

Additional Practice Example: Statement: No cats are dogs. All dogs are animals. Conclusion: No cats are animals. Is this valid?

Solution: *This conclusion is INVALID. The premises only tell us cats aren't dogs and dogs are animals — they say nothing preventing cats from also being animals (which, in reality, they are). The conclusion does not follow.*

Day 6 Quiz

1. Find the odd one out:

a) Whale
b) Dolphin
c) Shark
d) Salmon

Answer Key

1-c

Week 10 Mock Test

Two short tests to close out Week 10: first, a check on this week's material alone; second, a cumulative check pulling from every week so far, so earlier topics don't fade as you move forward.

Part A — Week 10 Only

1. Find the next number: 6, 13, 27, 55, ?
a) 110
b) 111
c) 112
d) 109

2. If 'MOUSE' is coded with each letter shifted +1, what is the code?
a) NPVTF
b) NPUTF
c) NPVTG
d) MPVTF

3. X is Y's father. Z is X's mother. How is Z related to Y?
a) Mother
b) Grandmother
c) Aunt
d) Sister

4. A man walks 8 km north, then 6 km east. His distance from the start is:
a) 10 km
b) 14 km
c) 2 km
d) 48 km

5. Six people sit around a circular table facing the center. If clue conflicts arise while solving, you should:
a) Ignore the conflicting clue
b) Recheck earlier deductions for an error
c) Assume multiple correct answers exist
d) Restart with a guess

6. Find the odd one out:
a) Whale
b) Dolphin
c) Shark
d) Salmon

7. Complete the analogy: Thermometer : Temperature :: Speedometer : ___
a) Distance
b) Speed

c) Time
d) Fuel

8. Statement: All engineers are logical. Some logical people are also creative. Conclusion: Some engineers are creative. This is:
a) True
b) False
c) Cannot be determined
d) Always false

9. Facing North and making three consecutive 90° right turns, you now face:
a) North
b) South
c) East
d) West

10. In a made-up code, if the whole alphabet is reversed (A=Z,B=Y,...), what does 'ZEBRA' become?
a) AVYIZ
b) AVYZI
c) AVIZY
d) AYVZI

Answer Key

1-b 2-a 3-b 4-a 5-b 6-c 7-b 8-c 9-d 10-a

Part B — Cumulative, Weeks 1-10

1. Find the next number: 2, 4, 8, 16, __
a) 18
b) 24
c) 32
d) 20

2. Complete the series: 1, 4, 9, 16, 25, ?
a) 30
b) 36
c) 32
d) 49

3. Which number should replace the question mark: 3, 9, 27, 81, ?
a) 162
b) 243
c) 324
d) 729

4. If CAT is coded as DBU, then DOG is coded as:
a) EPH
b) EPI
c) FQH

d) EQH

5. If in a certain code "BOOK" is written as "CPPL", how is "PAGE" written?
a) QBHF
b) QBHE
c) OZFD
d) QAHF

6. If in a code language "SUN" is written as "TVO", how is "MOON" written?
a) NPPO
b) NPPP
c) NPOP
d) NPPQ

7. Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?
a) Mother
b) Aunt
c) Sister
d) Grandmother

8. A is the father of B. C is the sister of A. What is C to B?
a) Mother
b) Aunt
c) Sister
d) Grandmother

9. If X is the son of Y, and Y is the mother of Z, what is Z to X (if Z is male)?
a) Father
b) Brother
c) Uncle
d) Cousin

10. If North becomes East, East becomes South, and so on (90° clockwise), what will South become?
a) North
b) West
c) East
d) South

11. A man walks 5 km north, then 3 km east, then 5 km south. How far is he from the starting point?
a) 3 km
b) 5 km
c) 8 km
d) 13 km

12. Facing North, if you turn 90° clockwise, you now face:
a) West
b) East
c) South

d) North

13. Five friends sit in a row. A is to the right of B, C is to the left of B. Who is in the middle (of these three)?

a) A
b) B
c) C
d) Cannot be determined

14. In a circular arrangement facing the center, 'left' of a person refers to:

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b) The counter-clockwise direction
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a) 3 or 4
b) 2
c) 5
d) 6

16. Complete the analogy: Doctor : Hospital :: Teacher : ___

a) Book
b) School
c) Student
d) Chalk

17. Find the odd one out:

a) Triangle
b) Square
c) Circle
d) Sphere

18. Complete the analogy: Pen : Write :: Knife : ___

a) Sharp
b) Cut
c) Kitchen
d) Metal

19. Find the next number: 4, 9, 16, 25, ?

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b) 36
c) 32
d) 49

20. If in a code 'TEA' is written as 'UFB' (each letter +1), how is 'CUP' written?

a) DVQ
b) DVR

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d) DWQ

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a) II only
b) II and III only
c) I, II, and III
d) None of the statements is true

25. Which sentence below probably is NOT being used to make a claim (a statement)?
a) Financial ruin from medical bills is common in some countries
b) I wonder if we should turn back
c) I learned that minor surgery means someone else is operated on
d) My bumper sticker asks about love at first sight

26. If a headline says "New Pill Controls Birth Twice a Month," the most likely INTENDED meaning is:
a) The pill controls pregnancy twice a month
b) The new pill can be taken twice a month to control pregnancy
c) Taking the pill twice a month promotes birth
d) None of these

27. What is the conclusion indicator in: "If it rains, it's a bad day for a picnic. So, we shouldn't go, since Svetlana heard it's raining."
a) Then
b) At least
c) So

d) No conclusion

28. Find the next number: 6, 13, 27, 55, ?

a) 110
b) 111
c) 112
d) 109

29. If 'MOUSE' is coded with each letter shifted +1, what is the code?

a) NPVTF
b) NPUTF
c) NPVTG
d) MPVTF

30. X is Y's father. Z is X's mother. How is Z related to Y?

a) Mother
b) Grandmother
c) Aunt
d) Sister

Answer Key

1-c 2-b 3-b 4-a 5-a 6-a 7-a 8-b 9-b 10-b 11-a 12-b 13-b 14-b 15-a 16-b 17-d 18-b 19-b 20-a 21-a 22-c 23-a 24-a 25-b 26-b 27-c 28-b 29-a 30-b

Logical Reasoning — Solved Problem Bank

A set of fully worked problems spanning the whole subject, useful for a final confidence check before moving to the next part. Try each problem yourself before reading the solution.

Problem 1: Find the next term: 2, 5, 10, 17, 26, ?

Solution: *The differences are 3, 5, 7, 9 (increasing odd numbers). The next difference should be 11, giving 26+11 = 37.*

Problem 2: If in a code 'GARDEN' is written as 'HBSEFO' (each letter +1), decode 'IFMMP'.

Solution: *Reverse the shift by subtracting 1 from each letter: I→H, F→E, M→L, M→L, P→O, giving 'HELLO'.*

Problem 3: A is B's mother. C is B's son. What is A to C?

Solution: *A is B's mother, and C is B's son (so B is C's parent). A is therefore the grandmother of C.*

Problem 4: A man walks 6 km east, turns right, walks 4 km, turns right again, walks 6 km. How far is he from his start, and in what direction?

Solution: *East 6 km (facing East), turn right → facing South, walk 4 km. Turn right again → facing West, walk 6 km. The eastward and westward legs (6 km each) cancel out entirely, leaving only the 4 km southward leg — he is 4 km south (in the south direction) of the start.*

Problem 5: Five people P,Q,R,S,T sit in a row. Q is second from the left. P is immediately right of Q. T is at the right end. Where can R and S sit?

Solution: *Positions 1-5 from left. Q is at position 2. P is at position 3 (immediately right of Q). T is at position 5. That leaves positions 1 and 4 for R and S in some order — the exact assignment needs an additional clue to fully resolve, but both must occupy positions 1 and 4.*

Problem 6: Complete the analogy: Ounce : Weight :: Litre : ___

Solution: *Following the pattern 'unit : quantity it measures', Litre measures Volume.*

Problem 7: Statement: All squares are rectangles. All rectangles have four sides. Conclusion: All squares have four sides.

Solution: *This is a valid syllogism: since every square is a rectangle (first premise), and every rectangle has four sides (second premise), it necessarily follows that every square has four sides. The conclusion is TRUE and validly follows.*

Problem 8: Find the odd one out: Kilogram, Litre, Metre, Gram.

Solution: *Kilogram and Gram measure mass, Metre measures length, and Litre measures volume — but if grouping by 'is a mass unit', Litre and Metre are the two non-mass units; the single cleanest classification is that Litre measures volume while the other three (Kilogram, Gram, Metre — though Metre is length) — reconsidering, the cleanest odd-one-out is Litre, since Kilogram and Gram are both mass units and Metre, while a different quantity, is at least a base SI unit like the gram; the most defensible single answer is Litre (the only volume unit).*

Problem 9: If facing North-East and you turn 90° clockwise, which direction do you face?

Solution: *Rotating 90° clockwise from North-East lands you on South-East (each 90° clockwise turn moves you two positions around an 8-point compass, or equivalently, directly perpendicular to the original diagonal direction).*

Problem 10: Six friends sit around a circular table facing the center. A is opposite D. B is to the immediate right of A. Where is B relative to D?

Solution: *Since A and D are opposite each other, and B is immediately right of A, B is immediately to the LEFT of D (opposite relationships reverse left/right when moving to the other side of the circle).*

Problem 11: Find the next term: 3, 7, 15, 31, ?

Solution: *The pattern is ×2 then +1 each time (3×2+1=7, 7×2+1=15, 15×2+1=31), so the next term is 31×2+1 = 63.*

Problem 12: If in a code 'FRIEND' becomes 'EQHDMC' (each letter −1), decode 'DSFBM'.

Solution: *Reverse by adding 1 to each letter: D→E, S→T, F→G, B→C, M→N, giving 'ETGCN' — checking against likely intended word patterns, this shift-back method decodes consistently letter by letter regardless of whether the result forms a common word.*

Problem 13: A is the brother of B. B is the daughter of C. D is C's husband. How is D related to A?

Solution: *C is B's mother, and D is C's husband, so D is B's father. Since A is B's brother, D is also A's father.*

Problem 14: A man walks 10 km north, then 10 km east, then 10 km south. Find his distance and direction from start.

Solution: *The north and south legs (10 km each) cancel out, leaving only the 10 km eastward leg — he is 10 km east of the starting point.*

Problem 15: Complete the analogy: Author : Manuscript :: Composer : ___

Solution: *Following 'creator : their created work', a Composer creates a Symphony (or musical Score).*

Problem 16: Statement: No cats are dogs. All dogs are animals. Conclusion: No cats are animals. Is this valid?

Solution: *This conclusion is INVALID. The premises only tell us cats aren't dogs and dogs are animals — they say nothing preventing cats from also being animals (which, in reality, they are). The conclusion does not follow.*

Problem 17: In a row of 7 people, P is 3rd from the left and 3rd from the right. Is this possible, and what does it imply?

Solution: *For a row of 7, being 3rd from the left means position 3, and 3rd from the right in a 7-person row also means position 5 (7−3+1=5) — these do not match, so this scenario is impossible unless P is exactly in the middle (position 4) of an odd-length row of 7, which would make P 4th from both ends, not 3rd — so the given condition is inconsistent for a row of exactly 7.*

Problem 18: Find the odd one out: Square, Cube, Rectangle, Circle.

Solution: *Cube is a 3-dimensional solid, while Square, Rectangle, and Circle are all 2-dimensional shapes — Cube is the odd one out.*

Problem 19: A is North of B. C is East of B. What direction is C from A?

Solution: *Since C is east of B, and A is directly north of B, C is South-East of A.*

Problem 20: Complete the series: J, F, M, A, M, ? (first letters of months)

Solution: *January, February, March, April, May, so next is June: J.*

Problem 21: Statement: Some cats are black. All black things absorb heat. Conclusion: Some cats absorb heat. Is this valid?

Solution: *Yes, this is valid: since some cats are (in the category of) black things, and all black things absorb heat, those specific cats must absorb heat.*

Problem 22: If in a code 'RIVER' becomes 'SJWFS' (each letter +1), what does 'OCEAN' become?

Solution: *Shift each letter forward by 1: O→P, C→D, E→F, A→B, N→O, giving 'PDFBO'.*

Logical Reasoning — Glossary of Key Terms

A quick-reference glossary. Read through it once, then use it to test yourself: cover the definitions and try to recall each one from the term alone.

Term	Definition
Analogy	A comparison showing that two pairs of things share the same underlying relationship.
Blood Relation	A reasoning problem type involving deducing family relationships from given statements.
Coding-Decoding	A reasoning problem type where letters/words are transformed by a hidden rule, to be identified and reapplied.
Conclusion (Logical)	A statement that necessarily follows from given premises in a valid argument.
Direction Sense	A reasoning problem type involving tracking movement and orientation using compass directions.
Odd One Out	A reasoning problem type asking which item does not share a property common to the others.
Premise	A statement assumed true, used as the basis for a logical argument or conclusion.
Seating Arrangement	A reasoning problem type involving deducing the relative positions of people from given clues.
Syllogism	A form of logical reasoning where a conclusion is drawn from two given premises/statements.
Series Completion	A reasoning problem type requiring identification of a numeric or alphabetic pattern to find missing terms.
Cardinal Direction	One of the four main compass points: North, East, South, West.
Critical Reasoning	A reasoning problem type testing evaluation of arguments, assumptions, and conclusions.
Statement-Conclusion	A reasoning problem type asking whether given conclusions logically follow from a stated premise.
Venn Diagram	A diagram using overlapping circles to represent logical relationships between sets or categories.
Deductive Reasoning	Reasoning from general premises to a specific, logically certain conclusion.
Inductive Reasoning	Reasoning from specific observations to a general (probable, not certain) conclusion.
Cardinal Point	One of the four main compass directions: North, South, East, West.
Validity (logic)	A property of an argument where the conclusion necessarily follows from the premises, regardless of real-world truth.

PART 6

Revision Weeks, Exam Strategy & Mock Tests

Week 11: Complete Revision Schedule (Daily)

With every subject's Week 1-10 content now covered day by day, Week 11 rotates a full day through each major area, followed by a full mock test on the 7th day.

Day 1 (Monday): Calculus — re-derive every rule from memory, then redo the Mathematics Solved Problem Bank items 1-10.

Day 2 (Tuesday): Linear Algebra — matrices, determinants, eigenvalues; redo Solved Problem Bank items 11-20.

Day 3 (Wednesday): Statistics — distributions, hypothesis testing, regression; full glossary review.

Day 4 (Thursday): Data Structures + DBMS — trees, graphs, SQL, normalization; CS glossary review.

Day 5 (Friday): Operating Systems + Networks — scheduling, deadlocks, OSI/TCP-IP.

Day 6 (Saturday): English + Logical Reasoning — full glossary and solved-problem review for both subjects.

Day 7 (Sunday): Combined Full Mock (100 Questions, 2 Hours) — assemble from the five subjects' Week 10 'Part B — Cumulative' tests; see below.

Week 12: Final Preparation (Daily)

Day 1: Mixed-subject revision (1 hr) + timed MCQ practice, 50 questions (1 hr) + error review (1 hr).

Day 2: Repeat the Day 1 structure, focusing weak areas identified from Day 1's error review.

Day 3: Combined Full Mock (assembled from the five Week 10 cumulative tests) under strict timed conditions, then a full review of every wrong answer.

Day 4: Mixed-subject revision + timed MCQ practice + error review, focusing on your two weakest subjects.

Day 5: A second Combined Full Mock under strict timed conditions, then a full review of every wrong answer.

Day 6: Light revision only: formula sheets, glossaries, and solved-problem banks — no new material.

Day 7 (exam eve/day): A third Combined Full Mock earlier in the week if possible; otherwise rest, review the Final Checklist, and prepare documents for exam day.

Mock practice target: solve 100-150 MCQs/week from Week 4 onward, increasing to 200+ MCQs/week during the final three weeks.

Exam Day Strategy

Time budgeting: with 100 questions in 120 minutes, that's roughly 72 seconds per question on average — but not every question deserves equal time. A practical split: spend the first 45 minutes on Mathematics and Statistics (50 questions, your highest-value, often most time-consuming section), the next 45 minutes on Computer Science, English, and Reasoning (50 questions, generally faster to answer), and reserve the final 30 minutes to revisit flagged questions and fill in any guesses.

Since there is no negative marking, never leave a question blank — even an educated guess (eliminating 1-2 clearly wrong options first) has positive expected value over leaving it empty.

Order of attack: do a first pass answering every question you're confident about immediately, and mark uncertain ones instead of freezing on them. A second pass returns to marked questions with fresh eyes and the time-pressure of 'how many are left' clearly known, rather than mixing quick wins with slow struggles in a single linear pass.

Common time traps to avoid: re-reading a Reasoning puzzle's clues from scratch multiple times instead of sketching a diagram once; getting stuck trying to recall an exact formula instead of re-deriving it quickly from first principles; and second-guessing an English grammar answer you were initially confident about — first instincts on grammar are usually correct when you've studied the rules properly.

The night before: do a light review of your formula sheets and glossary tables rather than attempting new practice questions — sleep and mental freshness matter more at this point than one more hour of study. On the morning of the exam, do a handful of easy warm-up questions (e.g. from Week 1 Day 1 of any subject) to settle your mind before the real thing.

During the exam itself, resist the urge to change an answer purely on a second-guess feeling with no new reasoning behind it — research on exam performance consistently shows that first-instinct changes made without a clear logical reason are more likely to turn a correct answer into a wrong one than the reverse. Only change an answer if you spot a concrete error in your first calculation or a misread word in the question.

A daily study log habit worth adopting throughout all 12 weeks: at the end of each day, write one sentence noting the single topic you found hardest that day. Reviewing this running list weekly

tells you exactly where to focus your Sunday review sessions, rather than guessing which topics need more attention.

How Mock Testing Works In This Book

Rather than a handful of large standalone mock tests at the very end, this book gives every week its own two-part mock test, right after that week's six days of study (see the end of each 'Week N' section in Parts 1-5):

Part A - Week N Only: checks whether you've actually absorbed the week you just finished.

Part B - Cumulative, Weeks 1-N: pulls a small sample from every week so far (including the current one), so earlier topics stay fresh instead of fading once you move on. This part grows slightly each week, so by Week 10 it functions as a genuine full-syllabus test for that subject.

For a complete, exam-realistic simulation once you've finished all five subjects, combine the five Week 10 'Part B - Cumulative' tests (Mathematics, Statistics, Computer Science & IT, English, Logical Reasoning) into a single timed 2-hour, 100-question session, in the same 25/25/25/10/15 proportion as the real exam. Do this at least twice during Week 12 under strict exam conditions.

Common Mistakes to Avoid, By Subject

Mathematics

Forgetting the '+C' on indefinite integrals — while rarely the deciding factor in a multiple-choice option, it reflects sloppy habits that cause errors elsewhere. Dropping the inner-function derivative when applying the chain rule (e.g. writing d/dx[sin(3x)] as cos(3x) instead of 3cos(3x)) is the single most common calculus slip under time pressure. In linear algebra, confusing the conditions for a matrix to be invertible (non-zero determinant) with the conditions for eigenvalues to be real (symmetric matrix) causes avoidable errors — these are two separate facts about two different matrix properties.

Statistics

Mixing up when to use n versus n-1 in the variance formula — always use n-1 for a sample statistic meant to estimate a population parameter. Confusing which test (Z, t, or chi-square) applies to a given scenario is extremely common; a fast mental checklist is: categorical data → chi-square; numeric data with known variance or large n → Z; numeric data with unknown variance and small n → t. Misreading a confidence level's meaning (treating a 95% CI as 'a 95% chance this interval contains the true value' rather than the correct long-run interpretation) is a frequent conceptual trap in MCQ wording.

Computer Science & IT

Confusing time complexity notation — remembering that O(log n) is faster-growing than O(1) but slower than O(n) is a common point of confusion; always rank them mentally from the standard order: $O(1) < O(\log n) < O(n) < O(n \log n) < O(n^2) < O(2^n)$. Mixing up INNER JOIN and OUTER JOIN behavior, and forgetting that a primary key must be both unique and NOT NULL simultaneously (not just one or the other), are also frequent slip-ups.

Technical English

Subject-verb agreement traps involving 'each', 'every', 'neither...nor', and collective nouns ('the number of...') account for a large share of missed English questions — when in doubt, isolate the true grammatical subject and ignore any words in between. Misapplying tense-shift rules in indirect speech (forgetting that 'will' becomes 'would', or that time expressions like 'tomorrow' need to shift to 'the next day') is another frequent, easily fixable error.

Logical Reasoning

Assuming a syllogism conclusion follows just because it 'sounds reasonable' in the real world, rather than checking if it is a strict logical necessity given only the stated premises, is the most common reasoning error. In seating/direction puzzles, forgetting to clarify whether people are facing inward or outward in a circular arrangement (which flips left/right) causes avoidable mistakes — always confirm this detail before solving.

Recommended Resources

Mathematics: Thomas' Calculus; Gilbert Strang - Introduction to Linear Algebra

Statistics: Sheldon Ross - Introduction to Probability; Walpole - Probability & Statistics

Computer Science: GeeksforGeeks; Neso Academy (YouTube); Gate Smashers (YouTube)

English: Wren & Martin; GRE Vocabulary Lists

Logical Reasoning: R.S. Aggarwal - A Modern Approach to Verbal & Non-Verbal Reasoning

Final Pre-Exam Checklist

Use this checklist in your final week of preparation:

☐ I can re-derive every derivative/integral rule in the Mathematics formula sheet from memory.

☐ I can compute mean, variance, and identify the right distribution (Binomial/Poisson/Normal) for a given word problem.

☐ I can state the difference between a Z-test, t-test, and chi-square test, and when to use each.

☐ I can write basic SQL (SELECT/WHERE/JOIN/GROUP BY) and explain normalization up to 3NF.

☐ I can explain the OSI model layers and the difference between TCP and UDP.

☐ I have reviewed the Technical English glossary and can use each word in a sentence.

☐ I can solve a blood-relation, direction-sense, and seating-arrangement puzzle within 90 seconds each.

☐ I have completed every week's two-part mock test (Parts A & B) across all five subjects, plus at least two Combined Full Mocks under strict timed conditions, reviewing every wrong answer.

☐ I know my exam center, symbol number, and required documents for exam day.

☐ I have a plan for time budgeting across the five sections (see Exam Day Strategy in Part 6).

☐ I have kept a daily study log and know which topics I flagged as hardest across all 12 weeks.

Good luck — consistent, focused daily practice across these five subjects is exactly what this exam rewards.

MASTER IN DATA SCIENCE (MDS) ENTRANCE EXAMINATION

Practice Question Bank — 30 Sets

(Original practice questions modeled on the official exam pattern — for self-study only)

How to use this booklet:

1. Each of the 30 sets has 100 questions in the same pattern as the real exam: Mathematics (25), Statistics (25), Computer Science & IT (25), Technical English (10), and Logical Reasoning (15).
2. Attempt one full set at a time under a strict 2-hour timer, then check against that set's Answer Key printed right after it.
3. Sets are generated from a shared, verified question bank with shuffled question order and shuffled answer choices each time, so the same underlying question may occasionally reappear across different sets (usually with options in a different order) — treat that as reinforcement, not a mistake.
4. There is no negative marking — attempt every question.

PRACTICE SET 1

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $e^x/2$ b) $x\,e^x/2$ c) $x^2\,e^x$ d) e^x

2. A square matrix A is called orthogonal if:
a) $\det(A) = 0$ b) $A\,A^T = I$ c) $A^2 = I$ d) $A = A^T$

3. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) ∞ b) 1 c) 0 d) Undefined

4. A continuous function on a closed and bounded interval [a, b] is always:
a) Unbounded on [a, b] b) Differentiable on [a, b] c) Monotonic on [a, b] d) Uniformly continuous on [a, b]

5. The derivative of $\ln(\sin x)$ is:
a) $\tan x$ b) $-\cot x$ c) $\cot x$ d) $\sec x$

6. Let $f(x) = |x - 1|$. Which of the following about f at $x = 1$ is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I and III only b) II only c) I only d) III only

7. The value of $\int_0^{\pi} \sin x\,dx$ is:
a) π b) 0 c) 1 d) 2

8. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Oscillatory b) Divergent c) Conditionally convergent d) Convergent

9. A monotonic decreasing bounded sequence converges to its:
a) Supremum b) Infimum c) Upper bound d) Maximum

10. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) -1 b) 2 c) 0 d) 1

11. Which of the following is an even function?
a) $\cos x$ b) x c) x^3 d) $\sin x$

12. Let $f(x) = x^2$ for $x \leq 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) An even function b) Continuous but not differentiable at $x = 0$ c) Discontinuous at $x = 0$ d) Differentiable at $x = 0$

13. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A\,e^{3x} + B\,e^{-3x}$ b) $A\cosh 3x + B\sinh 3x$ c) $A\cos 3x + B\sin 3x$ d) $A\,e^{9x} + B\,e^{-9x}$

14. Which of the following sets is countable?
a) Irrational numbers b) The interval [0, 1] c) Real numbers d) Rational numbers

15. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(3,−1) b) u=(1,1), v=(1,1) c) u=(1,−1), v=(1,1) d) u=(2,1), v=(1,2)

16. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = Ae^x + Be^{-x}$ b) $y = A\cos x + B\sin x$ c) $y = Ae^{ix}$ d) $y = A + Bx$

17. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 2 b) 0 c) 1 d) 3

18. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 0 b) 3 c) 2 d) 1

19. The determinant of a triangular matrix equals:

a) The square of its trace b) The product of its diagonal elements c) Zero always d) The sum of its diagonal elements

20. The average value of $f(x) = x^2$ on the interval [0, 3] is:

a) 1 b) 3 c) 27 d) 9

21. The general solution of $dy/dx = y/x$ is:

a) $y = Ce^x$ b) $y = Cx^2$ c) $y = C/x$ d) $y = Cx$

22. The curve y = x^(1/3) at (0, 0) has:

a) No tangent b) An oblique tangent c) A horizontal tangent d) A vertical tangent

23. The eigenvalues of the matrix [[0,1],[1,0]] are:

a) 0, 0 b) 1, −1 c) 1, 1 d) −1, −1

24. The value of $\int e^x \cos x \, dx$ is:

a) $e^x \cos x + C$ b) $(e^x/2)(\sin x + \cos x) + C$ c) $e^x \sin x + C$ d) $(e^x/2)(\sin x - \cos x) + C$

25. The radius of convergence of the series $\Sigma x^n/n!$ is:

a) 0 b) e c) ∞ d) 1

Section II: Statistics (1×25=25)

26. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:

a) Law of Large Numbers b) Chebyshev's Inequality c) Central Limit Theorem d) Bayes' Theorem

27. The standard normal distribution has mean and variance:

a) 1 and 1 b) 0 and 0 c) 1 and 0 d) 0 and 1

28. For a Poisson distribution, which of the following is true?

a) None of the above b) Mean > Variance c) Mean = Variance d) Mean < Variance

29. Which measure of central tendency is most affected by extreme values (outliers)?

a) None of the above b) Mode c) Median d) Mean

30. The coefficient of determination R^2 measures:

a) The proportion of variation in the independent variable explained by the dependent variable b) None of the above c) The total unexplained variation in the model d) The proportion of variation in the dependent variable explained by the independent variable

31. The p-value in hypothesis testing represents:

a) The probability of observing the data (or more extreme), given H_0 is true b) The probability that H_1 is true c) The significance level itself d) The probability that H_0 is true

32. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:

a) $Z = (a-\mu)\sigma$ b) $Z = (a-\mu)/\sigma^2$ c) $Z = (a-\mu)/\sqrt{n}$ d) $Z = (a-\mu)/\sigma$

33. If two events A and B are independent, then $P(A \cap B)$ equals:

a) P(A)/P(B) b) P(A) + P(B) c) P(A) − P(B) d) P(A)·P(B)

34. If the correlation coefficient r = 0 between X and Y, it implies:

a) No relationship at all between X and Y b) A perfect relationship between X and Y c) No linear relationship between X and Y d) A negative relationship between X and Y

35. In time series analysis, the mathematical method most commonly used for measuring trend is:

a) Semi-average method b) Least squares method c) Moving average method d) Free-hand curve method

36. The variance of a constant c is:

a) c^2 b) Undefined c) c d) 0

37. The binomial distribution tends to the normal distribution when:
a) $n \to \infty$, p fixed b) $n \to 0$ c) $np \to \lambda$ (finite) d) $p \to 0$, $n \to \infty$, np fixed

38. In the hypergeometric distribution, the mean nK/N represents:
a) The population mean b) The mode c) The expected number of successes in the sample d) The variance

39. The appropriate statistical test for comparing means across more than two independent groups is:
a) Z-test b) Chi-square test c) F-test (ANOVA) d) t-test

40. In stratified sampling, the population is divided into:
a) Equal-sized random groups b) Homogeneous subgroups (strata) c) Systematic intervals d) Random clusters

41. The probability of an impossible event is:
a) 1 b) 0 c) Undefined d) 0.5

42. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ^2 and λ b) λ and λ c) λ and λ^2 d) $1/\lambda$ and $1/\lambda^2$

43. In simple random sampling without replacement from a finite population, each unit has:
a) A probability depending on order drawn b) Zero probability of selection c) An unequal probability of selection d) An equal probability of selection

44. The chi-square test statistic can never be:
a) Positive b) Zero c) Negative d) A decimal value

45. The geometric mean of 2, 4, and 8 is:
a) 4.67 b) 5 c) 4 d) 8

46. In hypothesis testing, a Type II error occurs when we:
a) Reject H_0 when H_0 is true b) None of the above c) Reject H_1 when H_1 is true d) Accept H_0 when H_0 is false

47. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) $(n-1)/2$ b) $(n+1)/2$ c) $n/2$ d) $n^2/2$

48. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_n(0.5)^x$ b) ${}_nC_x(0.5)^n$ c) ${}_nC_x(0.5)^x$ d) ${}_nC_x(0.5)^{(n-x)}$

49. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 15 b) 60 c) 125 d) 10

50. The best fitted trend line is the one for which the sum of squares of errors is:
a) Negative b) Zero c) Maximum d) Minimum

Section III: Computer Science and Information Technology (1×25=25)

51. IP in the context of networking stands for:
a) Information Packet b) Internet Protocol c) Interface Path d) Internal Process

52. Which of the following best describes cloud computing?
a) Storing data only on local computers b) A hardware component c) Delivering computing services (storage, servers, software) over the internet d) A type of programming language

53. Which data structure works on the LIFO (Last In First Out) principle?
a) Stack b) Queue c) Linked list d) Array

54. The ability of objects to take on multiple forms is called:
a) Polymorphism b) Abstraction c) Inheritance d) Encapsulation

55. The OSI model has how many layers?
a) 8 b) 5 c) 6 d) 7

56. Which of the following statements is executed by the preprocessor?
a) void main() b) return 0; c) printf("Hello"); d) #define PI 3.14

57. In machine learning, overfitting refers to a model that:
a) Performs equally well on all datasets b) Performs poorly on training data c) Performs well on training data but poorly on new/unseen data d) Cannot be trained at all

58. Which of the following is the most common metric for measuring algorithm efficiency?
a) Lines of code b) Time complexity (Big-O) c) Memory size d) Programming language used

59. Which SDLC phase focuses on gathering and documenting user requirements?
a) Requirement Analysis b) Maintenance c) Design d) Testing

60. Which switching technique requires a dedicated path between sender and receiver?
a) Circuit switching b) Packet switching c) Message switching d) None of the above

61. Which of the following is a valid IPv4 address?
a) 192.168.1.1 b) 192.168.1 c) 192.168.1.256 d) 192.168.1.1.1

62. Which normal form removes partial dependency on a composite primary key?
a) 3NF b) 2NF c) 1NF d) BCNF

63. Which of the following statements is true regarding relational database keys?
a) A relation can have only one candidate key b) A relation can have only one primary key c) A relation can have only one foreign key d) A relation can have multiple candidate keys

64. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Excel b) Photoshop c) MS Paint d) SPSS

65. A firewall is primarily used to:
a) Control and filter network traffic for security b) Store data backups c) Compress files d) Speed up an internet connection

66. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.192 b) 255.255.255.128 c) 255.255.255.0 d) 255.255.255.224

67. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Inheritance b) Encapsulation c) Polymorphism d) Abstraction

68. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Persistence b) Refresh rate c) Phosphorescence d) Fluorescence

69. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 4NF b) 1NF c) 2NF d) BCNF

70. A primary key can contain:
a) Duplicate values b) Only NULL values c) Neither duplicate nor NULL values d) NULL values

71. The result of $(11010)_2 - (1011)_2$ is:
a) 01110 b) 11100 c) 01111 d) 10101

72. A deadlock in an operating system occurs when:
a) None of the above b) A process uses too much CPU c) Two or more processes wait indefinitely for resources held by each other d) A process completes execution

73. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 4 b) 6 c) 5 d) 10

74. Which of the following is an entry-controlled loop?
a) None of the above b) while c) do-while d) Both while and do-while

75. Which of the following is not a Database Management System?
a) MySQL b) Windows c) PostgreSQL d) Oracle

Section IV: Technical English (1×10=10)

76. "The thief was caught red-handed by the police." This means:
a) The thief was caught while committing the crime b) The thief was injured c) The thief's hands were painted red d) The police painted the thief's hand

77. "He is the black sheep of the family." The underlined expression has …… meaning.
a) Figurative b) Poetic c) Contextual d) Literal

78. Choose the word closest in meaning to 'meticulous':
a) Confused b) Careful and precise c) Quick d) Careless

79. Identify the correctly punctuated sentence:
a) Although it was, raining we went for a walk. b) Although, it was raining we went for a walk. c) Although it was raining, we went for a walk. d) Although it was raining we, went for a walk.

80. 'He is used to _____ early.'
a) waken b) wake c) woke d) waking

81. Which of the following is a compound sentence?
a) Singing well is her passion. b) She sings well, and she dances gracefully. c) Because she practices, she sings well. d) She sings well.

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:
a) Renewable energy is gaining importance due to environmental benefits b) Governments dislike renewable energy c) Fossil fuels are better than renewables d) Wind energy is the only alternative

83. The mode of approach in the passage is:
a) Descriptive b) Argumentative c) Poetic d) Narrative

84. According to the passage, one benefit of renewable energy is:
a) High cost b) Limited availability c) Requiring fossil fuel input d) Low greenhouse gas emissions

85. The most appropriate title for the passage is:
a) Climate Change Effects b) Solar Power Only c) The Decline of Fossil Fuels d) Renewable Energy: A Sustainable Future

Section V: Logical Reasoning (1×15=15)

86. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Cannot be determined b) Partially follows c) Follows d) Does not follow

87. Find the next term: 1, 4, 9, 16, 25, ___
a) 32 b) 36 c) 30 d) 49

88. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) The Earth revolves around the Sun b) He scored the highest marks in class c) Could you please close the door? d) Water boils at 100°C at sea level

89. Choose the word that does NOT belong with the others:
a) Triangle b) Square c) Circle d) Cube

90. Find the odd one out:

a) Banana b) Carrot c) Mango d) Apple

91. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) Both a and b b) No conclusion c) since d) so

92. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.

If the above are true, which must also be true?

I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly

a) II and III only b) I, II, and III c) II only d) None of the statements is true

93. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Daughter b) Aunt c) Mother d) Sister

94. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) TBCMF b) UACMF c) UBCMF d) UBCLF

95. All cats are animals. No animal is a plant. Therefore:

a) All plants are animals b) No conclusion can be drawn c) Some cats are plants d) No cat is a plant

96. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 67 b) 65 c) 61 d) 63

97. Which of the following is NOT a useful principle for making scientific progress?

a) Divide the problem into manageable components b) Look only for confirming evidence and ignore disconfirming evidence c) Compare similar cases to isolate the relevant difference d) Actively seek disconfirming evidence as well

98. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EOH b) DPH c) EPH d) EPG

99. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 18 b) 20 c) 24 d) 22

100. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) No Bloops are Lazzies b) Some Lazzies are not Razzies c) All Lazzies are Bloops d) All Bloops are Lazzies

Answer Key — Set 1

1	2	3	4	5	6	7	8	9	10
b	b	b	d	c	a	d	b	b	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	b	a	d	a	b	a	c	b	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
d	d	b	b	c	c	d	c	d	d
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	d	d	c	b	d	a	c	c	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
b	b	d	c	c	d	b	b	c	d
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	c	a	a	d	d	c	b	a	a
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
a	b	d	a	a	a	a	d	d	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	c	c	b	b	a	a	b	c	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	a	a	d	d	c	b	c	d	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	a	d	c	d	b	b	c	b	d

PRACTICE SET 2

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3ⁿ is:
a) 2(2/3)⁵ b) 6(2/3)⁵ c) 3(2/3)⁵ d) 6(2/3)⁴

2. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 4e^(2x) b) −4e^(2x) c) 0 d) e^(2x)

3. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 120 b) 3125 c) 5 d) 25

4. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Undefined c) Unity d) Zero

5. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/34 b) 5/√34 c) 3/√34 d) 4/√34

6. Let f: (0,1) → (0,1) be defined by f(x) = x². Then f is:
a) One-one and onto b) One-one but not onto c) Neither one-one nor onto d) Onto but not one-one

7. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Infimum b) Minimum c) Maximum d) Supremum

8. The value of lim (n→∞) (1 + 1/n)ⁿ is:
a) 0 b) e c) 1 d) ∞

9. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Symmetric b) Orthogonal c) Invertible d) Singular

10. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) It diverges b) e c) ln 2 d) 1

11. The Wronskian of two linearly dependent functions is:
a) −1 b) 0 c) Undefined d) 1

12. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 3, 3 b) 2, −2 c) 6, 0 d) 4, 2

13. The integrating factor of the differential equation dy/dx + y/x = x² is:
a) ln x b) 1/x c) x² d) x

14. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π/2 b) π/4 c) 1 d) π

15. Which of the following statements is true?
a) Every sequence has a limit b) Every monotonic sequence converges c) Every convergent sequence is bounded
d) Every bounded sequence is convergent

16. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 6 b) 4/3 c) 9 d) 3/4

17. The locus of the equation xz + yz = 0 is:
a) A straight line b) A pair of parallel planes c) A pair of perpendicular planes d) A single plane

18. The nullity of a 4×4 identity matrix is:
a) 0 b) Undefined c) 4 d) 1

19. The Laplace transform of sinh(3t) is:

a) $3/(s^2+9)$ b) $3/(s^2-9)$ c) $s/(s^2-9)$ d) $s/(s^2+9)$

20. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 3 b) 1 c) 0 d) 2

21. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Invertible b) Orthogonal c) Symmetric d) Singular

22. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) 1 b) π c) $\pi/4$ d) $\pi/2$

23. The Laplace transform of sinh(3t) is:
a) $3/(s^2-9)$ b) $s/(s^2+9)$ c) $3/(s^2+9)$ d) $s/(s^2-9)$

24. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A\,e^{9x} + B\,e^{-9x}$ b) $A\cosh 3x + B\sinh 3x$ c) $A\cos 3x + B\sin 3x$ d) $A\,e^{3x} + B\,e^{-3x}$

25. The sequence $b_n = \sum_{k=1}^{n} 1/(n+k)$ converges to:
a) ln 2 b) e c) 1 d) It diverges

Section II: Statistics (1×25=25)

26. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 5 b) 3 c) 6 d) 4

27. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Kurtosis of X b) Skewness of X c) Variance of X d) Mean of X

28. The sum of squares of deviations is minimum when measured from the:
a) Mean b) Median c) Mode d) Geometric mean

29. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) (r−1)(c−1) b) rc c) r + c − 2 d) r + c

30. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15 b) 23 c) 16 d) 15.5

31. The standard deviation of a distribution is always:
a) Zero b) Negative c) Undefined d) Non-negative

32. Which distribution is used for testing the equality of two population variances?
a) Chi-square distribution b) t-distribution c) F-distribution d) Normal distribution

33. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ b) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$ c) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$

34. In usual notation, if E(X) = 3 and $E(X^2) = 13$, then the standard deviation of X is:
a) 4 b) 2 c) 13 d) 9

35. Testing H_0: $\mu \le 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided upper-tailed test b) Two-tailed test c) One-sided lower-tailed test d) None of the above

36. The coefficient of variation is computed using the formula:
a) (mean × s.d.)/100 b) 100/(mean × s.d.) c) (s.d./mean) × 100 d) (mean/s.d.) × 100

37. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Arithmetic mean b) Geometric mean c) Median d) Harmonic mean

38. The correlation coefficient r always lies between:
a) $-\infty$ and ∞ b) 0 and ∞ c) −1 and 1 d) 0 and 1

39. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:

a) 1/2 b) 5/8 c) 1/8 d) 3/8

40. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Zero c) Positive d) Negative

41. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Wider b) Cannot be determined c) The same width d) Narrower

42. The statistical test generally used to test association between two independent categorical variables is:
a) t-test b) Chi-square test c) F-test d) Z-test

43. If the two observations are 15 and −15, then their harmonic mean is:
a) ∞ (undefined) b) 15 c) 0 d) −15

44. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) −0.2 b) 0.3 c) 0.1 d) 0.2

45. A Type I error is also known as:
a) Sampling error b) Alpha error (false positive) c) Standard error d) Beta error

46. The p-value in hypothesis testing represents:
a) The probability of observing the data (or more extreme), given H_0 is true b) The probability that H_1 is true c) The significance level itself d) The probability that H_0 is true

47. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Positive b) Unity c) Negative d) Zero

48. The coefficient of variation is computed using the formula:
a) (mean/s.d.) × 100 b) (s.d./mean) × 100 c) (mean × s.d.)/100 d) 100/(mean × s.d.)

49. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sigma^2$ b) $Z = (a-\mu)\sigma$ c) $Z = (a-\mu)/\sigma$ d) $Z = (a-\mu)/\sqrt{n}$

50. In hypothesis testing, a Type II error occurs when we:
a) Reject H_0 when H_0 is true b) Accept H_0 when H_0 is false c) Reject H_1 when H_1 is true d) None of the above

Section III: Computer Science and Information Technology (1×25=25)

51. Which system development approach is best suited when requirements evolve continuously?
a) V-model b) Waterfall c) Agile d) None of the above

52. HTTP stands for:
a) HyperText Transfer Protocol b) HyperText Transmission Process c) Host Transfer Text Protocol d) High Transfer Text Protocol

53. Which of the following is a NoSQL database?
a) MongoDB b) PostgreSQL c) MySQL d) Oracle

54. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Bubble sort c) Selection sort d) Quick sort

55. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) SELECT, FROM, WHERE c) FROM, SELECT, WHERE d) WHERE, SELECT, FROM

56. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) DELETE c) REMOVE d) TRUNCATE

57. Which layer is responsible for routing data across different networks?
a) Data link layer b) Application layer c) Physical layer d) Network/Internet layer

58. Which of the following is used to uniquely identify a device on a network?

a) HTML tag b) Domain name c) MAC address d) URL

59. Recursion in programming is best described as:

a) A loop with no exit condition b) A data structure c) A function that never returns d) A function calling itself to solve smaller instances of a problem

60. Which class of language is recognized by a pushdown automaton?

a) Context-sensitive language b) Context-free language c) Recursively enumerable language d) Regular language

61. Which of the following is a compiled language?

a) JavaScript b) PHP c) C d) Python

62. Round-robin scheduling is the preemptive version of:

a) First Come First Serve (FCFS) b) Priority Scheduling c) None of the above d) Shortest Job First

63. Which protocol is used to send email?

a) HTTP b) FTP c) SNMP d) SMTP

64. Which data structure is typically used for Breadth-First Search (BFS) traversal?

a) Stack b) Graph c) Tree d) Queue

65. Which diagram is used to represent the flow of data in structured software analysis?

a) Data Flow Diagram (DFD) b) Entity Relationship diagram c) Use-case diagram d) Class diagram

66. Which of the following is an example of secondary memory?

a) Hard disk b) Cache c) RAM d) Register

67. Which of the following is an example of supervised learning?

a) Principal Component Analysis b) Association rule mining c) Linear regression d) K-means clustering

68. Which of the following information is required to normalize a relation into 3NF?

a) None of the above b) Join dependency c) Functional dependency d) Multivalued dependency

69. The time complexity of binary search on a sorted array of n elements is:

a) O(n log n) b) O(log n) c) O(1) d) O(n)

70. After a rollback, a transaction is in _____ state.

a) Aborted b) Active c) Partially committed d) Committed

71. Which of the following information is required to normalize a relation into 3NF?

a) Multivalued dependency b) Join dependency c) Functional dependency d) None of the above

72. Which SDLC phase focuses on gathering and documenting user requirements?

a) Design b) Maintenance c) Requirement Analysis d) Testing

73. A firewall is primarily used to:

a) Store data backups b) Control and filter network traffic for security c) Speed up an internet connection d) Compress files

74. Which normal form is based on candidate keys and removes all transitive dependencies fully?

a) 1NF b) 4NF c) BCNF d) 2NF

75. Which class of language is recognized by a pushdown automaton?

a) Regular language b) Context-free language c) Context-sensitive language d) Recursively enumerable language

Section IV: Technical English (1×10=10)

76. Choose the correctly spelled word:

a) Receve b) Recieve c) Receiv d) Receive

77. 'Actions speak louder than words' means:

a) Actions are always loud b) What people do matters more than what they say c) Silence is golden d) Words are more powerful than actions

78. The antonym of 'diligent' is:

a) Punctual b) Careful c) Hardworking d) Lazy

79. Choose the correct form: 'One of the students _____ absent today.'

a) is b) were c) are d) have been

80. The idiom 'to hit the nail on the head' means:

a) To hurt someone b) To make a mistake c) To say or do something exactly right d) To work with tools

81. Choose the correct passive voice of 'She is writing a letter.'

a) A letter is written by her b) A letter was being written by her c) A letter is being written by her d) A letter has been written by her

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:

a) Job displacement and data privacy b) AI is only used in healthcare c) AI cannot analyze data d) AI is too expensive

83. According to the passage, what do experts recommend?

a) A balanced approach combining innovation and ethical safeguards b) Ignoring privacy concerns c) Using AI only in finance d) Banning AI completely

84. The tone of the passage is:

a) Sarcastic b) Purely critical c) Balanced and analytical d) Purely promotional

85. The most suitable title for the passage is:

a) Artificial Intelligence: Opportunities and Challenges b) Healthcare Systems Today c) The Dangers of Technology d) Finance in the Modern Age

Section V: Logical Reasoning (1×15=15)

86. Find the missing number: 2, 5, 10, 17, 26, ___

a) 38 b) 36 c) 35 d) 37

87. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Father b) Uncle c) Grandfather d) Brother

88. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 61 b) 62 c) 63 d) 64

89. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Sunday b) Friday c) Monday d) Saturday

90. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 44 b) 40 c) 36 d) 42

91. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Painting Found Near a Tree b) Tree Found Stolen Painting c) Painting Found Stolen by a Tree d) Tree Stole a Painting

92. Statement: Regular exercise improves cardiovascular health and mental well-being.

Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Neither I nor II follows b) Both I and II follow c) Only conclusion II follows d) Only conclusion I follows

93. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 98 b) 120 c) 112 d) 84

94. Circle is to Sphere as Square is to:
a) Cone b) Rectangle c) Cylinder d) Cube

95. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 24 b) 18 c) 22 d) 20

96. Fill in the blank: MBN NBO OBP PBQ _____
a) QBR b) QBQ c) PBR d) RBQ

97. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the brother of c b) a is the uncle of c c) a is the father of c d) a is the son of c

98. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) ligowin b) bota c) winbo d) bowin

99. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion I follows b) Only conclusion II follows c) Both I and II follow d) Neither I nor II follows

100. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Only conclusion I follows b) Only conclusion II follows c) Neither I nor II follows d) Both I and II follow

Answer Key — Set 2

1	2	3	4	5	6	7	8	9	10
b	c	a	d	b	b	a	b	d	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	d	d	b	c	d	c	a	b	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
d	c	a	d	a	a	c	a	a	d
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	c	c	b	a	c	b	c	d	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	b	a	d	b	a	a	b	c	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	a	a	d	a	a	d	c	d	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	a	d	d	a	a	c	c	b	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**

c	c	b	c	b	d	b	d	a	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	a	a	c	a	d	a	c	d	d
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	d	c	d	d	a	b	d	a	a

PRACTICE SET 3

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The locus of the equation xz + yz = 0 is:
a) A single plane b) A pair of parallel planes c) A pair of perpendicular planes d) A straight line

2. The curve y = x^(1/3) at (0, 0) has:
a) A horizontal tangent b) A vertical tangent c) An oblique tangent d) No tangent

3. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 0 b) -1 c) 2 d) 1

4. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A \cos x + B \sin x$ b) $y = Ae^x + Be^{-x}$ c) $y = Ae^{ix}$ d) $y = A + Bx$

5. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 2 b) 1 c) 0 d) 3

6. The value of $\lim_{(n\to\infty)} (1 + 1/n)^n$ is:
a) ∞ b) e c) 1 d) 0

7. The value of ∫₀^π sin x dx is:
a) π b) 1 c) 0 d) 2

8. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, 1 b) −1, −1 c) 1, −1 d) 0, 0

9. The value of $\lim_{(x\to 0)} (\sin x)/x$ is:
a) Undefined b) ∞ c) 1 d) 0

10. The determinant of a triangular matrix equals:
a) The square of its trace b) The product of its diagonal elements c) The sum of its diagonal elements d) Zero always

11. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 25 b) 3125 c) 120 d) 5

12. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $e^x/2$ b) $x\, e^x/2$ c) e^x d) $x^2 e^x$

13. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Convergent b) Conditionally convergent c) Oscillatory d) Divergent

14. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/√34 b) 4/√34 c) 3/√34 d) 5/34

15. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 0 b) 4e^(2x) c) −4e^(2x) d) e^(2x)

16. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) ∞ b) e c) 0 d) 1

17. The nullity of a 4×4 identity matrix is:
a) 0 b) 4 c) Undefined d) 1

18. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one but not onto b) Neither one-one nor onto c) One-one and onto d) Onto but not one-one

19. A square matrix A is called orthogonal if:

a) $A\,A^T = I$ b) $\det(A) = 0$ c) $A^2 = I$ d) $A = A^T$

20. Which of the following sets is countable?
a) Rational numbers b) Real numbers c) Irrational numbers d) The interval [0, 1]

21. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 0 b) 1 c) 2 d) 3

22. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 6, 0 b) 3, 3 c) 4, 2 d) 2, −2

23. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 0 b) 2 c) 1 d) 3

24. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3ⁿ is:
a) $6(2/3)^4$ b) $3(2/3)^5$ c) $2(2/3)^5$ d) $6(2/3)^5$

25. Let $f(x) = x^2$ for $x \leq 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) An even function b) Differentiable at x = 0 c) Discontinuous at x = 0 d) Continuous but not differentiable at x = 0

Section II: Statistics (1×25=25)

26. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Chebyshev's Inequality b) Central Limit Theorem c) Law of Large Numbers d) Bayes' Theorem

27. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Moving average method b) Semi-average method c) Least squares method d) Free-hand curve method

28. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/8\}$ b) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/2\}$ c) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/2\}$ d) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/8\}$

29. A Type I error is also known as:
a) Sampling error b) Standard error c) Beta error d) Alpha error (false positive)

30. In the hypergeometric distribution, the mean nK/N represents:
a) The population mean b) The expected number of successes in the sample c) The mode d) The variance

31. The binomial distribution tends to the normal distribution when:
a) $n \to \infty$, p fixed b) $n \to 0$ c) $np \to \lambda$ (finite) d) $p \to 0$, $n \to \infty$, np fixed

32. The correlation coefficient r always lies between:
a) 0 and 1 b) −1 and 1 c) 0 and ∞ d) −∞ and ∞

33. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) $1/\lambda$ and $1/\lambda^2$ b) λ^2 and λ c) λ and λ d) λ and λ^2

34. The appropriate statistical test for comparing means across more than two independent groups is:
a) t-test b) Z-test c) Chi-square test d) F-test (ANOVA)

35. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mean b) Median c) None of the above d) Mode

36. The geometric mean of 2, 4, and 8 is:
a) 8 b) 4.67 c) 5 d) 4

37. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) −0.2 b) 0.1 c) 0.3 d) 0.2

38. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.

a) Arithmetic mean b) Median c) Geometric mean d) Harmonic mean

39. The best fitted trend line is the one for which the sum of squares of errors is:
a) Maximum b) Minimum c) Negative d) Zero

40. Which distribution is used for testing the equality of two population variances?
a) Chi-square distribution b) t-distribution c) Normal distribution d) F-distribution

41. The standard deviation of a distribution is always:
a) Undefined b) Zero c) Negative d) Non-negative

42. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) - P(B)$ b) $P(A) + P(B)$ c) $P(A) \cdot P(B)$ d) $P(A)/P(B)$

43. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 15 b) 60 c) 125 d) 10

44. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 1/8 c) 5/8 d) 1/2

45. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) $(n+1)/2$ b) $(n-1)/2$ c) $n/2$ d) $n^2/2$

46. The coefficient of determination R^2 measures:
a) The proportion of variation in the dependent variable explained by the independent variable b) The total unexplained variation in the model c) The proportion of variation in the independent variable explained by the dependent variable d) None of the above

47. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) Cannot be determined c) The same width d) Wider

48. The probability of an impossible event is:
a) 0 b) Undefined c) 0.5 d) 1

49. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) None of the above b) Two-tailed test c) One-sided upper-tailed test d) One-sided lower-tailed test

50. The chi-square test statistic can never be:
a) A decimal value b) Zero c) Positive d) Negative

Section III: Computer Science and Information Technology (1×25=25)

51. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) SELECT, FROM, WHERE d) WHERE, SELECT, FROM

52. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Inheritance b) Encapsulation c) Abstraction d) Polymorphism

53. Which layer is responsible for routing data across different networks?
a) Network/Internet layer b) Physical layer c) Application layer d) Data link layer

54. The OSI model has how many layers?
a) 8 b) 5 c) 7 d) 6

55. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 4 b) 6 c) 10 d) 5

56. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.224 b) 255.255.255.0 c) 255.255.255.128 d) 255.255.255.192

57. Round-robin scheduling is the preemptive version of:
a) None of the above b) Shortest Job First c) First Come First Serve (FCFS) d) Priority Scheduling

58. A primary key can contain:
a) Neither duplicate nor NULL values b) Duplicate values c) Only NULL values d) NULL values

59. The time complexity of binary search on a sorted array of n elements is:
a) O(log n) b) O(n log n) c) O(1) d) O(n)

60. The ability of objects to take on multiple forms is called:
a) Inheritance b) Abstraction c) Encapsulation d) Polymorphism

61. Which of the following statements is true regarding relational database keys?
a) A relation can have only one candidate key b) A relation can have only one foreign key c) A relation can have only one primary key d) A relation can have multiple candidate keys

62. Which of the following is not a Database Management System?
a) MySQL b) Oracle c) PostgreSQL d) Windows

63. The result of $(11010)_2 - (1011)_2$ is:
a) 01110 b) 01111 c) 10101 d) 11100

64. HTTP stands for:
a) HyperText Transmission Process b) High Transfer Text Protocol c) Host Transfer Text Protocol d) HyperText Transfer Protocol

65. Which of the following is a NoSQL database?
a) Oracle b) PostgreSQL c) MySQL d) MongoDB

66. Which of the following is a compiled language?
a) PHP b) Python c) JavaScript d) C

67. Recursion in programming is best described as:
a) A function that never returns b) A function calling itself to solve smaller instances of a problem c) A loop with no exit condition d) A data structure

68. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Queue b) Stack c) Tree d) Graph

69. Which of the following is an example of secondary memory?
a) RAM b) Hard disk c) Register d) Cache

70. Which of the following is an entry-controlled loop?
a) do-while b) Both while and do-while c) while d) None of the above

71. Which protocol is used to send email?
a) SMTP b) HTTP c) SNMP d) FTP

72. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Paint b) MS Excel c) Photoshop d) SPSS

73. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Fluorescence b) Phosphorescence c) Refresh rate d) Persistence

74. Which normal form removes partial dependency on a composite primary key?
a) 1NF b) 3NF c) BCNF d) 2NF

75. Which of the following best describes cloud computing?
a) Delivering computing services (storage, servers, software) over the internet b) A type of programming language c) Storing data only on local computers d) A hardware component

Section IV: Technical English (1×10=10)

76. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Adjective b) Verb c) Adverb d) Noun

77. Choose the correctly punctuated sentence:
a) Its a nice day b) It is'nt a nice day c) Its' a nice day d) It's a nice day

78. The synonym of 'abundant' is:
a) Scarce b) Limited c) Rare d) Plentiful

79. The phrase 'in the nick of time' means:
a) In the near future b) Too late c) At the very last possible moment d) At the beginning

80. Neither the teacher nor the students …… present.
a) were b) was c) has been d) is

81. 'By the time we arrived, the movie _____.'
a) already started b) already starts c) had already started d) has already started

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:
a) None of the above b) Agriculture c) Only entertainment d) Education, healthcare, and employment

83. Which of the following is mentioned as a challenge of urbanization?
a) Low population b) Excess housing c) Abundant farmland d) Traffic congestion

84. What does the passage suggest is essential for livable cities?
a) Reducing population to zero b) Sustainable urban planning c) Removing green spaces d) Banning public transport

85. The passage is primarily about:
a) Rural life b) The history of cities c) Global warming d) The opportunities and challenges of urbanization

Section V: Logical Reasoning (1×15=15)

86. Look at the series: 5, 9, 17, 33, ___. What number should come next?
a) 61 b) 63 c) 67 d) 65

87. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Both I and II follow b) Only conclusion II follows c) Neither I nor II follows d) Only conclusion I follows

88. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 20 b) 22 c) 18 d) 24

89. Fill in the blank: MBN NBO OBP PBQ _____
a) QBR b) QBQ c) RBQ d) PBR

90. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."
a) since b) Both a and b c) No conclusion d) so

91. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) All Lazzies are Bloops b) Some Lazzies are not Razzies c) No Bloops are Lazzies d) All Bloops are Lazzies

92. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 44 b) 40 c) 42 d) 36

93. Find the next term: 1, 4, 9, 16, 25, ___

a) 36 b) 30 c) 49 d) 32

94. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Painting Found Stolen by a Tree b) Painting Found Near a Tree c) Tree Found Stolen Painting d) Tree Stole a Painting

95. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.

Conclusion II: The economic slowdown affected the company.

Which one is true?

a) Neither I nor II follows b) Only conclusion I follows c) Only conclusion II follows d) Both I and II follow

96. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 62 b) 61 c) 64 d) 63

97. Which number should replace the question mark: 7, 14, 28, 56, ?

a) 84 b) 98 c) 112 d) 120

98. Circle is to Sphere as Square is to:

a) Cylinder b) Cube c) Rectangle d) Cone

99. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EPG b) EPH c) EOH d) DPH

100. Read the following carefully:

I. P+Q means P is the son of Q

II. P−Q means P is the wife of Q

III. P×Q means P is the brother of Q

IV. P÷Q means P is the mother of Q

V. P=Q means P is the sister of Q

What does a×b÷c mean?

a) a is the brother of c b) a is the uncle of c c) a is the son of c d) a is the father of c

Answer Key — Set 3

1	2	3	4	5	6	7	8	9	10
c	b	d	a	a	b	d	c	c	b
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	b	d	a	a	a	a	a	a	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	c	d	d	d	b	c	d	d	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	b	c	d	a	d	d	c	b	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
d	c	c	a	a	a	d	a	c	d
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	a	a	c	d	d	c	a	a	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	d	b	d	d	d	b	a	b	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	b	a	d	a	c	d	d	c	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	d	d	b	d	d	d	a	a	d
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	c	a	b	b	d	c	b	b	b

PRACTICE SET 4

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) III only c) II only d) I and III only

2. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 3 b) 27 c) 9 d) 1

3. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 9 b) 4/3 c) 6 d) 3/4

4. A monotonic decreasing bounded sequence converges to its:
a) Maximum b) Infimum c) Supremum d) Upper bound

5. Which of the following is an even function?
a) cos x b) x c) sin x d) x^3

6. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Infimum b) Minimum c) Supremum d) Maximum

7. The general solution of dy/dx = y/x is:
a) y = Cx b) $y = Cx^2$ c) $y = Ce^x$ d) y = C/x

8. The derivative of ln(sin x) is:
a) cot x b) −cot x c) sec x d) tan x

9. The value of $\int e^x \cos x \, dx$ is:
a) $(e^x/2)(\sin x - \cos x) + C$ b) $e^x \cos x + C$ c) $e^x \sin x + C$ d) $(e^x/2)(\sin x + \cos x) + C$

10. A continuous function on a closed and bounded interval [a, b] is always:
a) Unbounded on [a, b] b) Uniformly continuous on [a, b] c) Differentiable on [a, b] d) Monotonic on [a, b]

11. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x b) 1/x c) x^2 d) ln x

12. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Unity c) Undefined d) Zero

13. The Wronskian of two linearly dependent functions is:
a) −1 b) 1 c) Undefined d) 0

14. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(2,1), v=(1,2) b) u=(1,1), v=(1,1) c) u=(1,−1), v=(1,1) d) u=(1,1), v=(3,−1)

15. Which of the following statements is true?
a) Every monotonic sequence converges b) Every bounded sequence is convergent c) Every convergent sequence is bounded d) Every sequence has a limit

16. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/√34 b) 4/√34 c) 5/34 d) 3/√34

17. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) ∞ b) 1 c) e d) 0

18. Which of the following sets is countable?
a) Rational numbers b) Irrational numbers c) Real numbers d) The interval [0, 1]

19. The derivative of ln(sin x) is:
a) cot x b) −cot x c) sec x d) tan x

20. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, 1 b) 1, −1 c) 0, 0 d) −1, −1

21. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) e^(2x) b) −4e^(2x) c) 0 d) 4e^(2x)

22. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1 b) 2 c) 3 d) 0

23. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) e b) ln 2 c) It diverges d) 1

24. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) II only c) III only d) I and III only

25. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cosh3x + B sinh3x b) $A\ e^{3x} + B\ e^{-3x}$ c) $A\ e^{9x} + B\ e^{-9x}$ d) A cos3x + B sin3x

Section II: Statistics (1×25=25)

26. If the two observations are 15 and −15, then their harmonic mean is:
a) ∞ (undefined) b) 15 c) 0 d) −15

27. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Kurtosis of X b) Skewness of X c) Variance of X d) Mean of X

28. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 5 b) 3 c) 6 d) 4

29. In a binomial distribution, if the probability of success π = 0.5, then Pr(X=x) is given by:
a) $_nC_n(0.5)^x$ b) $_nC_x(0.5)^{(n-x)}$ c) $_nC_x(0.5)^x$ d) $_nC_x(0.5)^n$

30. The sum of squares of deviations is minimum when measured from the:
a) Median b) Geometric mean c) Mode d) Mean

31. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 23 b) 16 c) 15.5 d) 15

32. If the correlation coefficient r = 0 between X and Y, it implies:
a) No relationship at all between X and Y b) No linear relationship between X and Y c) A perfect relationship between X and Y d) A negative relationship between X and Y

33. The standard normal distribution has mean and variance:
a) 0 and 1 b) 1 and 0 c) 0 and 0 d) 1 and 1

34. The variance of a constant c is:
a) c^2 b) Undefined c) c d) 0

35. For a Poisson distribution, which of the following is true?
a) Mean = Variance b) Mean < Variance c) Mean > Variance d) None of the above

36. In stratified sampling, the population is divided into:
a) Random clusters b) Systematic intervals c) Equal-sized random groups d) Homogeneous subgroups (strata)

37. In usual notation, if E(X) = 3 and $E(X^2) = 13$, then the standard deviation of X is:
a) 9 b) 2 c) 13 d) 4

38. The statistical test generally used to test association between two independent categorical variables is:

a) Chi-square test b) Z-test c) t-test d) F-test

39. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) rc b) r + c − 2 c) r + c d) (r−1)(c−1)

40. In simple random sampling without replacement from a finite population, each unit has:
a) A probability depending on order drawn b) An equal probability of selection c) An unequal probability of selection d) Zero probability of selection

41. If the correlation coefficient r = 0 between X and Y, it implies:
a) No linear relationship between X and Y b) A negative relationship between X and Y c) No relationship at all between X and Y d) A perfect relationship between X and Y

42. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Negative b) Positive c) Zero d) Unity

43. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) 1/λ and 1/λ² b) λ and λ c) λ² and λ d) λ and λ²

44. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) Wider c) Cannot be determined d) The same width

45. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c b) (r−1)(c−1) c) r + c − 2 d) rc

46. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Skewness of X b) Kurtosis of X c) Mean of X d) Variance of X

47. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Semi-average method b) Moving average method c) Least squares method d) Free-hand curve method

48. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) t-test c) Z-test d) Chi-square test

49. The binomial distribution tends to the normal distribution when:
a) $n \to 0$ b) $np \to \lambda$ (finite) c) $n \to \infty$, p fixed d) $p \to 0$, $n \to \infty$, np fixed

50. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 6 b) 5 c) 3 d) 4

Section III: Computer Science and Information Technology (1×25=25)

51. Which diagram is used to represent the flow of data in structured software analysis?
a) Use-case diagram b) Entity Relationship diagram c) Data Flow Diagram (DFD) d) Class diagram

52. Which system development approach is best suited when requirements evolve continuously?
a) None of the above b) V-model c) Waterfall d) Agile

53. A deadlock in an operating system occurs when:
a) A process uses too much CPU b) None of the above c) A process completes execution d) Two or more processes wait indefinitely for resources held by each other

54. Which data structure works on the LIFO (Last In First Out) principle?
a) Array b) Stack c) Queue d) Linked list

55. Which switching technique requires a dedicated path between sender and receiver?
a) Packet switching b) Circuit switching c) Message switching d) None of the above

56. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) TRUNCATE c) DELETE d) REMOVE

57. IP in the context of networking stands for:

a) Information Packet b) Interface Path c) Internal Process d) Internet Protocol

58. Which of the following statements is executed by the preprocessor?
a) #define PI 3.14 b) printf("Hello"); c) return 0; d) void main()

59. Which of the following is an example of supervised learning?
a) Association rule mining b) K-means clustering c) Linear regression d) Principal Component Analysis

60. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1.1 c) 192.168.1 d) 192.168.1.1.1

61. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Selection sort c) Quick sort d) Bubble sort

62. Which of the following is used to uniquely identify a device on a network?
a) Domain name b) URL c) MAC address d) HTML tag

63. In machine learning, overfitting refers to a model that:
a) Performs well on training data but poorly on new/unseen data b) Cannot be trained at all c) Performs poorly on training data d) Performs equally well on all datasets

64. After a rollback, a transaction is in _____ state.
a) Committed b) Active c) Partially committed d) Aborted

65. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Memory size c) Time complexity (Big-O) d) Lines of code

66. Recursion in programming is best described as:
a) A data structure b) A function calling itself to solve smaller instances of a problem c) A loop with no exit condition d) A function that never returns

67. Which system development approach is best suited when requirements evolve continuously?
a) Agile b) Waterfall c) None of the above d) V-model

68. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Persistence b) Refresh rate c) Phosphorescence d) Fluorescence

69. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Stack c) Queue d) Tree

70. Which diagram is used to represent the flow of data in structured software analysis?
a) Entity Relationship diagram b) Class diagram c) Use-case diagram d) Data Flow Diagram (DFD)

71. Which normal form removes partial dependency on a composite primary key?
a) 2NF b) BCNF c) 3NF d) 1NF

72. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.128 b) 255.255.255.224 c) 255.255.255.192 d) 255.255.255.0

73. A deadlock in an operating system occurs when:
a) A process uses too much CPU b) Two or more processes wait indefinitely for resources held by each other c) None of the above d) A process completes execution

74. Which of the following is not a Database Management System?
a) PostgreSQL b) Windows c) MySQL d) Oracle

75. Which of the following is an example of supervised learning?
a) Linear regression b) K-means clustering c) Principal Component Analysis d) Association rule mining

Section IV: Technical English (1×10=10)

76. Choose the correct comparative form: 'This problem is _____ than the previous one.'

a) difficultest b) most difficult c) more difficult d) difficult

77. He asked me ……

a) that where I lived b) where I will live c) where I lived d) that where do I live

78. Choose the word closest in meaning to 'meticulous':

a) Careless b) Careful and precise c) Quick d) Confused

79. He asked me ……

a) that where I lived b) where I lived c) where I will live d) that where do I live

80. The idiom 'to hit the nail on the head' means:

a) To make a mistake b) To say or do something exactly right c) To hurt someone d) To work with tools

81. The synonym of 'abundant' is:

a) Scarce b) Plentiful c) Limited d) Rare

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:

a) Governments dislike renewable energy b) Wind energy is the only alternative c) Fossil fuels are better than renewables d) Renewable energy is gaining importance due to environmental benefits

83. The mode of approach in the passage is:

a) Descriptive b) Poetic c) Argumentative d) Narrative

84. According to the passage, one benefit of renewable energy is:

a) Limited availability b) High cost c) Low greenhouse gas emissions d) Requiring fossil fuel input

85. The most appropriate title for the passage is:

a) Climate Change Effects b) The Decline of Fossil Fuels c) Renewable Energy: A Sustainable Future d) Solar Power Only

Section V: Logical Reasoning (1×15=15)

86. Which of the following is NOT a useful principle for making scientific progress?

a) Compare similar cases to isolate the relevant difference b) Divide the problem into manageable components c) Look only for confirming evidence and ignore disconfirming evidence d) Actively seek disconfirming evidence as well

87. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.

Conclusion II: All erasers are pencils.

Which one is true?

a) Only conclusion I follows b) Neither I nor II follows c) Only conclusion II follows d) Both I and II follow

88. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) He scored the highest marks in class b) The Earth revolves around the Sun c) Water boils at 100°C at sea level d) Could you please close the door?

89. Find the missing number: 2, 5, 10, 17, 26, ___

a) 36 b) 37 c) 38 d) 35

90. All cats are animals. No animal is a plant. Therefore:

a) Some cats are plants b) All plants are animals c) No cat is a plant d) No conclusion can be drawn

91. Find the odd one out:

a) Apple b) Banana c) Carrot d) Mango

92. Choose the word that does NOT belong with the others:

a) Square b) Cube c) Triangle d) Circle

93. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UBCMF b) TBCMF c) UACMF d) UBCLF

94. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Saturday b) Sunday c) Monday d) Friday

95. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.

If the above are true, which must also be true?

I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly

a) None of the statements is true b) II and III only c) I, II, and III d) II only

96. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?

a) 18 b) 24 c) 20 d) 22

97. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Sister b) Daughter c) Mother d) Aunt

98. Statement: All students who study hard get good grades. Ram studies hard.

Conclusion: Ram gets good grades.

Does the conclusion follow?

a) Follows b) Partially follows c) Cannot be determined d) Does not follow

99. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Uncle b) Father c) Brother d) Grandfather

100. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) ligowin b) bota c) winbo d) bowin

Answer Key — Set 4

1	2	3	4	5	6	7	8	9	10
d	a	d	b	a	a	a	a	d	b
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	d	d	d	c	a	c	a	a	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	b	b	d	b	a	c	a	d	d
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
c	b	a	d	a	d	b	a	d	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	b	b	b	b	d	c	a	c	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	d	d	b	b	a	d	a	c	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	c	a	d	c	b	a	d	c	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	c	b	b	a	c	c	b	b	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	d	a	c	c	c	a	d	b	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
c	b	a	a	b	c	a	a	b	d

PRACTICE SET 5

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) ln x b) x^2 c) x d) 1/x

2. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 2 b) 1 c) 3 d) 0

3. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Orthogonal b) Invertible c) Singular d) Symmetric

4. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(3,−1) b) u=(2,1), v=(1,2) c) u=(1,−1), v=(1,1) d) u=(1,1), v=(1,1)

5. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 3125 b) 5 c) 120 d) 25

6. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3^n is:
a) $6(2/3)^5$ b) $3(2/3)^5$ c) $2(2/3)^5$ d) $6(2/3)^4$

7. A monotonic decreasing bounded sequence converges to its:
a) Maximum b) Infimum c) Upper bound d) Supremum

8. The Wronskian of two linearly dependent functions is:
a) Undefined b) 1 c) 0 d) −1

9. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Continuous but not differentiable at x = 0 b) An even function c) Discontinuous at x = 0 d) Differentiable at x = 0

10. Curl of the gradient of a scalar function is always:
a) Unity b) Undefined c) Equal to its divergence d) Zero

11. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) y = A + Bx b) y = A cos x + B sin x c) $y = Ae^{ix}$ d) $y = Ae^x + Be^{-x}$

12. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $x^2 e^x$ b) $x\, e^x/2$ c) $e^x/2$ d) e^x

13. $\int_0^1 1/(1+x^2)\, dx$ equals:
a) π b) π/4 c) π/2 d) 1

14. Which of the following is an even function?
a) x b) cos x c) sin x d) x^3

15. The nullity of a 4×4 identity matrix is:
a) 0 b) 1 c) Undefined d) 4

16. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) ∞ b) 0 c) 1 d) Undefined

17. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 4, 2 b) 3, 3 c) 2, −2 d) 6, 0

18. A continuous function on a closed and bounded interval [a, b] is always:
a) Unbounded on [a, b] b) Uniformly continuous on [a, b] c) Differentiable on [a, b] d) Monotonic on [a, b]

19. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:

a) One-one but not onto b) Neither one-one nor onto c) One-one and onto d) Onto but not one-one

20. Which of the following statements is true?

a) Every convergent sequence is bounded b) Every bounded sequence is convergent c) Every sequence has a limit d) Every monotonic sequence converges

21. The Laplace transform of sinh(3t) is:

a) $3/(s^2+9)$ b) $3/(s^2-9)$ c) $s/(s^2-9)$ d) $s/(s^2+9)$

22. The general solution of $dy/dx = y/x$ is:

a) $y = C/x$ b) $y = Ce^x$ c) $y = Cx^2$ d) $y = Cx$

23. The determinant of a triangular matrix equals:

a) The product of its diagonal elements b) Zero always c) The sum of its diagonal elements d) The square of its trace

24. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:

a) 1 b) 0 c) -1 d) 2

25. The value of $\int_0^{\pi} \sin x \, dx$ is:

a) 2 b) 1 c) π d) 0

Section II: Statistics (1×25=25)

26. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:

a) 9 b) 13 c) 2 d) 4

27. In simple random sampling without replacement from a finite population, each unit has:

a) An unequal probability of selection b) Zero probability of selection c) A probability depending on order drawn d) An equal probability of selection

28. The sum of squares of deviations is minimum when measured from the:

a) Median b) Mean c) Mode d) Geometric mean

29. The best fitted trend line is the one for which the sum of squares of errors is:

a) Minimum b) Zero c) Maximum d) Negative

30. The standard deviation of a distribution is always:

a) Negative b) Zero c) Non-negative d) Undefined

31. In stratified sampling, the population is divided into:

a) Homogeneous subgroups (strata) b) Random clusters c) Systematic intervals d) Equal-sized random groups

32. The coefficient of determination R^2 measures:

a) The total unexplained variation in the model b) The proportion of variation in the dependent variable explained by the independent variable c) None of the above d) The proportion of variation in the independent variable explained by the dependent variable

33. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:

a) $(n-1)/2$ b) $n^2/2$ c) $n/2$ d) $(n+1)/2$

34. The standard normal distribution has mean and variance:

a) 0 and 0 b) 1 and 0 c) 1 and 1 d) 0 and 1

35. The probability density function of a normal random variate X with mean 10 and variance 4 is:

a) $1/(2\sqrt{2\pi}) \exp\{-(x-10)^2/8\}$ b) $1/(2\sqrt{2\pi}) \exp\{-(x-10)^2/2\}$ c) $1/\sqrt{2\pi} \exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi} \exp\{-(x-10)^2/2\}$

36. The probability of an impossible event is:

a) 0 b) Undefined c) 1 d) 0.5

37. The median of the values 4, 8, 15, 16, 23, 42 is:

a) 16 b) 15 c) 15.5 d) 23

38. In hypothesis testing, a Type II error occurs when we:
a) Reject H_1 when H_1 is true b) None of the above c) Reject H_0 when H_0 is true d) Accept H_0 when H_0 is false

39. The correlation coefficient r always lies between:
a) −1 and 1 b) 0 and 1 c) 0 and ∞ d) −∞ and ∞

40. In the hypergeometric distribution, the mean nK/N represents:
a) The variance b) The expected number of successes in the sample c) The mode d) The population mean

41. If the two observations are 15 and −15, then their harmonic mean is:
a) 15 b) 0 c) ∞ (undefined) d) −15

42. The coefficient of variation is computed using the formula:
a) 100/(mean × s.d.) b) (s.d./mean) × 100 c) (mean × s.d.)/100 d) (mean/s.d.) × 100

43. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sqrt{n}$ b) $Z = (a-\mu)/\sigma$ c) $Z = (a-\mu)/\sigma^2$ d) $Z = (a-\mu)\sigma$

44. The variance of a constant c is:
a) c^2 b) Undefined c) 0 d) c

45. If two events A and B are independent, then $P(A \cap B)$ equals:
a) P(A) − P(B) b) P(A)·P(B) c) P(A)/P(B) d) P(A) + P(B)

46. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Harmonic mean b) Arithmetic mean c) Median d) Geometric mean

47. The p-value in hypothesis testing represents:
a) The probability of observing the data (or more extreme), given H_0 is true b) The probability that H_0 is true c) The significance level itself d) The probability that H_1 is true

48. The statistical test generally used to test association between two independent categorical variables is:
a) F-test b) t-test c) Z-test d) Chi-square test

49. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 1/2 b) 3/8 c) 1/8 d) 5/8

50. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_x(0.5)^{(n-x)}$ b) ${}_nC_n(0.5)^x$ c) ${}_nC_x(0.5)^n$ d) ${}_nC_x(0.5)^x$

Section III: Computer Science and Information Technology (1×25=25)

51. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 1NF b) 4NF c) BCNF d) 2NF

52. A primary key can contain:
a) Neither duplicate nor NULL values b) NULL values c) Duplicate values d) Only NULL values

53. Which of the following is a NoSQL database?
a) PostgreSQL b) Oracle c) MySQL d) MongoDB

54. Which of the following is a valid IPv4 address?
a) 192.168.1.1.1 b) 192.168.1.256 c) 192.168.1 d) 192.168.1.1

55. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Lines of code c) Time complexity (Big-O) d) Memory size

56. Which of the following is a compiled language?
a) PHP b) JavaScript c) Python d) C

57. Which SDLC phase focuses on gathering and documenting user requirements?

a) Testing b) Requirement Analysis c) Design d) Maintenance

58. After a rollback, a transaction is in _____ state.
a) Committed b) Aborted c) Active d) Partially committed

59. The time complexity of binary search on a sorted array of n elements is:
a) O(log n) b) O(n) c) O(n log n) d) O(1)

60. A firewall is primarily used to:
a) Speed up an internet connection b) Compress files c) Store data backups d) Control and filter network traffic for security

61. HTTP stands for:
a) High Transfer Text Protocol b) HyperText Transfer Protocol c) HyperText Transmission Process d) Host Transfer Text Protocol

62. Which of the following is an example of secondary memory?
a) Register b) RAM c) Cache d) Hard disk

63. The OSI model has how many layers?
a) 5 b) 6 c) 8 d) 7

64. Which class of language is recognized by a pushdown automaton?
a) Recursively enumerable language b) Context-free language c) Context-sensitive language d) Regular language

65. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Selection sort c) Quick sort d) Bubble sort

66. Which of the following is used to uniquely identify a device on a network?
a) Domain name b) URL c) MAC address d) HTML tag

67. The result of $(11010)_2 - (1011)_2$ is:
a) 11100 b) 10101 c) 01111 d) 01110

68. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 6 b) 5 c) 10 d) 4

69. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Paint b) SPSS c) Photoshop d) MS Excel

70. Which of the following is an entry-controlled loop?
a) do-while b) Both while and do-while c) None of the above d) while

71. Which of the following statements is executed by the preprocessor?
a) return 0; b) void main() c) printf("Hello"); d) #define PI 3.14

72. Round-robin scheduling is the preemptive version of:
a) Shortest Job First b) None of the above c) Priority Scheduling d) First Come First Serve (FCFS)

73. Which data structure works on the LIFO (Last In First Out) principle?
a) Linked list b) Queue c) Stack d) Array

74. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) DELETE c) TRUNCATE d) DROP

75. In machine learning, overfitting refers to a model that:
a) Performs poorly on training data b) Cannot be trained at all c) Performs equally well on all datasets d) Performs well on training data but poorly on new/unseen data

Section IV: Technical English (1×10=10)

76. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Adjective b) Verb c) Adverb d) Noun

77. 'He is used to _____ early.'
a) woke b) waken c) waking d) wake

78. The antonym of 'diligent' is:
a) Hardworking b) Punctual c) Lazy d) Careful

79. Choose the correct passive voice of 'She is writing a letter.'
a) A letter was being written by her b) A letter has been written by her c) A letter is written by her d) A letter is being written by her

80. "He is the black sheep of the family." The underlined expression has …… meaning.
a) Poetic b) Contextual c) Figurative d) Literal

81. Choose the correctly punctuated sentence:
a) It's a nice day b) It is'nt a nice day c) Its' a nice day d) Its a nice day

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:
a) AI is only used in healthcare b) Job displacement and data privacy c) AI cannot analyze data d) AI is too expensive

83. According to the passage, what do experts recommend?
a) Using AI only in finance b) A balanced approach combining innovation and ethical safeguards c) Banning AI completely d) Ignoring privacy concerns

84. The tone of the passage is:
a) Balanced and analytical b) Purely promotional c) Purely critical d) Sarcastic

85. The most suitable title for the passage is:
a) Finance in the Modern Age b) Healthcare Systems Today c) Artificial Intelligence: Opportunities and Challenges d) The Dangers of Technology

Section V: Logical Reasoning (1×15=15)

86. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 24 b) 18 c) 22 d) 20

87. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?
a) UACMF b) TBCMF c) UBCMF d) UBCLF

88. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion II follows b) Both I and II follow c) Only conclusion I follows d) Neither I nor II follows

89. Look at the series: 5, 9, 17, 33, ___. What number should come next?
a) 65 b) 61 c) 67 d) 63

90. Circle is to Sphere as Square is to:
a) Cone b) Rectangle c) Cube d) Cylinder

91. Which of the following is NOT a useful principle for making scientific progress?

a) Divide the problem into manageable components b) Look only for confirming evidence and ignore disconfirming evidence c) Actively seek disconfirming evidence as well d) Compare similar cases to isolate the relevant difference

92. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.

Conclusion II: The economic slowdown affected the company.

Which one is true?

a) Only conclusion II follows b) Neither I nor II follows c) Both I and II follow d) Only conclusion I follows

93. Find the missing number: 2, 5, 10, 17, 26, ___

a) 36 b) 38 c) 37 d) 35

94. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.

If the above are true, which must also be true?

I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly

a) II and III only b) I, II, and III c) II only d) None of the statements is true

95. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) ligowin b) bowin c) winbo d) bota

96. All cats are animals. No animal is a plant. Therefore:

a) Some cats are plants b) No conclusion can be drawn c) No cat is a plant d) All plants are animals

97. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) The Earth revolves around the Sun b) Could you please close the door? c) Water boils at 100°C at sea level d) He scored the highest marks in class

98. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EPH b) EOH c) DPH d) EPG

99. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Mother b) Sister c) Aunt d) Daughter

100. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 36 b) 42 c) 44 d) 40

Answer Key — Set 5

1	2	3	4	5	6	7	8	9	10
c	a	c	a	c	a	b	c	a	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	b	b	b	a	c	a	b	a	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	d	a	a	a	c	d	b	a	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	b	d	d	a	a	c	d	a	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	b	b	c	b	d	a	d	b	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	a	d	d	c	d	b	b	a	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b	d	d	b	c	c	c	b	d	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	d	c	d	d	c	c	c	d	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	b	b	a	c	d	c	c	a	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
b	d	c	a	b	c	b	a	b	b

PRACTICE SET 6

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The value of $\int e^x \cos x \, dx$ is:
a) $(e^x/2)(\sin x - \cos x) + C$ b) $e^x \sin x + C$ c) $(e^x/2)(\sin x + \cos x) + C$ d) $e^x \cos x + C$

2. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) An oblique tangent c) A horizontal tangent d) A vertical tangent

3. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Minimum b) Infimum c) Maximum d) Supremum

4. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 27 b) 1 c) 9 d) 3

5. A square matrix A is called orthogonal if:
a) $A = A^T$ b) $A A^T = I$ c) $\det(A) = 0$ d) $A^2 = I$

6. The radius of convergence of the series $\Sigma x^n/n!$ is:
a) 1 b) 0 c) e d) ∞

7. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 1 b) 2 c) 0 d) 3

8. The series $\Sigma 1/(n \ln n)$, $n \geq 2$, is:
a) Convergent b) Oscillatory c) Divergent d) Conditionally convergent

9. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 4/3 b) 3/4 c) 6 d) 9

10. The locus of the equation xz + yz = 0 is:
a) A single plane b) A pair of perpendicular planes c) A pair of parallel planes d) A straight line

11. Which of the following sets is countable?
a) Real numbers b) Irrational numbers c) Rational numbers d) The interval [0, 1]

12. A monotonic decreasing bounded sequence converges to its:
a) Upper bound b) Maximum c) Supremum d) Infimum

13. Which of the following is an even function?
a) sin x b) x c) cos x d) x^3

14. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 6 b) 3/4 c) 9 d) 4/3

15. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A \cos x + B \sin x$ b) $y = A + Bx$ c) $y = Ae^{ix}$ d) $y = Ae^x + Be^{-x}$

16. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) ln x b) x^2 c) x d) 1/x

17. A continuous function on a closed and bounded interval [a, b] is always:
a) Unbounded on [a, b] b) Monotonic on [a, b] c) Uniformly continuous on [a, b] d) Differentiable on [a, b]

18. The determinant of a triangular matrix equals:
a) Zero always b) The product of its diagonal elements c) The square of its trace d) The sum of its diagonal elements

19. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:

a) 0 b) 2 c) 1 d) 3

20. $\int_0^1 1/(1+x^2)\,dx$ equals:

a) π b) $\pi/4$ c) 1 d) $\pi/2$

21. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:

a) 0 b) 2 c) 1 d) 3

22. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:

a) An even function b) Discontinuous at x = 0 c) Differentiable at x = 0 d) Continuous but not differentiable at x = 0

23. The curve y = x^(1/3) at (0, 0) has:

a) A horizontal tangent b) An oblique tangent c) No tangent d) A vertical tangent

24. The eigenvalues of the matrix [[3,1],[1,3]] are:

a) 2, −2 b) 4, 2 c) 3, 3 d) 6, 0

25. The average value of $f(x) = x^2$ on the interval [0, 3] is:

a) 3 b) 9 c) 1 d) 27

Section II: Statistics (1×25=25)

26. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?

a) 60 b) 15 c) 10 d) 125

27. Which distribution is used for testing the equality of two population variances?

a) Normal distribution b) Chi-square distribution c) t-distribution d) F-distribution

28. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:

a) 0.2 b) 0.1 c) 0.3 d) −0.2

29. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:

a) Law of Large Numbers b) Bayes' Theorem c) Chebyshev's Inequality d) Central Limit Theorem

30. The geometric mean of 2, 4, and 8 is:

a) 4.67 b) 8 c) 5 d) 4

31. For a Poisson distribution, which of the following is true?

a) None of the above b) Mean < Variance c) Mean = Variance d) Mean > Variance

32. Testing H_0: $\mu \le 50$ vs H_1: $\mu > 50$ leads to:

a) Two-tailed test b) One-sided lower-tailed test c) None of the above d) One-sided upper-tailed test

33. Which measure of central tendency is most affected by extreme values (outliers)?

a) Mode b) Mean c) Median d) None of the above

34. A Type I error is also known as:

a) Standard error b) Beta error c) Alpha error (false positive) d) Sampling error

35. The chi-square test statistic can never be:

a) Zero b) A decimal value c) Negative d) Positive

36. The probability density function of a normal random variate X with mean 10 and variance 4 is:

a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ b) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$

37. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:

a) n/2 b) $n^2/2$ c) (n+1)/2 d) (n−1)/2

38. For a Poisson distribution, which of the following is true?
a) Mean < Variance b) Mean > Variance c) Mean = Variance d) None of the above

39. In the hypergeometric distribution, the mean nK/N represents:
a) The population mean b) The expected number of successes in the sample c) The mode d) The variance

40. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Least squares method b) Free-hand curve method c) Moving average method d) Semi-average method

41. The binomial distribution tends to the normal distribution when:
a) $n \to \infty$, p fixed b) $np \to \lambda$ (finite) c) $n \to 0$ d) $p \to 0$, $n \to \infty$, np fixed

42. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 4 c) 9 d) 2

43. If the correlation coefficient r = 0 between X and Y, it implies:
a) A negative relationship between X and Y b) A perfect relationship between X and Y c) No relationship at all between X and Y d) No linear relationship between X and Y

44. The sum of squares of deviations is minimum when measured from the:
a) Geometric mean b) Mean c) Median d) Mode

45. In stratified sampling, the population is divided into:
a) Homogeneous subgroups (strata) b) Random clusters c) Systematic intervals d) Equal-sized random groups

46. The geometric mean of 2, 4, and 8 is:
a) 4.67 b) 4 c) 8 d) 5

47. The standard normal distribution has mean and variance:
a) 0 and 0 b) 1 and 0 c) 1 and 1 d) 0 and 1

48. The statistical test generally used to test association between two independent categorical variables is:
a) Z-test b) F-test c) Chi-square test d) t-test

49. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Geometric mean b) Arithmetic mean c) Median d) Harmonic mean

50. The standard deviation of a distribution is always:
a) Zero b) Undefined c) Non-negative d) Negative

Section III: Computer Science and Information Technology (1×25=25)

51. Which switching technique requires a dedicated path between sender and receiver?
a) None of the above b) Circuit switching c) Packet switching d) Message switching

52. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Polymorphism b) Abstraction c) Encapsulation d) Inheritance

53. Which protocol is used to send email?
a) HTTP b) SMTP c) FTP d) SNMP

54. Which of the following information is required to normalize a relation into 3NF?
a) Join dependency b) Multivalued dependency c) Functional dependency d) None of the above

55. Which layer is responsible for routing data across different networks?
a) Data link layer b) Application layer c) Physical layer d) Network/Internet layer

56. Which of the following statements is true regarding relational database keys?
a) A relation can have only one foreign key b) A relation can have only one candidate key c) A relation can have multiple candidate keys d) A relation can have only one primary key

57. Which of the following best describes cloud computing?

a) Delivering computing services (storage, servers, software) over the internet b) A hardware component c) A type of programming language d) Storing data only on local computers

58. IP in the context of networking stands for:

a) Internal Process b) Information Packet c) Interface Path d) Internet Protocol

59. What is the correct logical order of execution of clauses in an SQL SELECT query?

a) FROM, SELECT, WHERE b) WHERE, SELECT, FROM c) FROM, WHERE, SELECT d) SELECT, FROM, WHERE

60. The ability of objects to take on multiple forms is called:

a) Inheritance b) Encapsulation c) Abstraction d) Polymorphism

61. HTTP stands for:

a) Host Transfer Text Protocol b) HyperText Transfer Protocol c) HyperText Transmission Process d) High Transfer Text Protocol

62. Which switching technique requires a dedicated path between sender and receiver?

a) Packet switching b) Message switching c) None of the above d) Circuit switching

63. The OSI model has how many layers?

a) 7 b) 8 c) 5 d) 6

64. The ability of objects to take on multiple forms is called:

a) Encapsulation b) Inheritance c) Abstraction d) Polymorphism

65. Which of the following information is required to normalize a relation into 3NF?

a) Join dependency b) Functional dependency c) None of the above d) Multivalued dependency

66. Which of the following best describes cloud computing?

a) A type of programming language b) Delivering computing services (storage, servers, software) over the internet c) A hardware component d) Storing data only on local computers

67. Which of the following is an entry-controlled loop?

a) Both while and do-while b) None of the above c) while d) do-while

68. Recursion in programming is best described as:

a) A function calling itself to solve smaller instances of a problem b) A loop with no exit condition c) A function that never returns d) A data structure

69. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:

a) Abstraction b) Inheritance c) Encapsulation d) Polymorphism

70. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:

a) Refresh rate b) Persistence c) Fluorescence d) Phosphorescence

71. Which data structure is typically used for Breadth-First Search (BFS) traversal?

a) Tree b) Queue c) Graph d) Stack

72. In machine learning, overfitting refers to a model that:

a) Cannot be trained at all b) Performs equally well on all datasets c) Performs poorly on training data d) Performs well on training data but poorly on new/unseen data

73. Which data structure works on the LIFO (Last In First Out) principle?

a) Array b) Stack c) Queue d) Linked list

74. Which diagram is used to represent the flow of data in structured software analysis?

a) Entity Relationship diagram b) Use-case diagram c) Data Flow Diagram (DFD) d) Class diagram

75. Round-robin scheduling is the preemptive version of:

a) None of the above b) Shortest Job First c) First Come First Serve (FCFS) d) Priority Scheduling

Section IV: Technical English (1×10=10)

76. Choose the correct comparative form: 'This problem is _____ than the previous one.'
a) most difficult b) difficultest c) more difficult d) difficult

77. 'By the time we arrived, the movie _____.'
a) had already started b) already started c) already starts d) has already started

78. 'Actions speak louder than words' means:
a) What people do matters more than what they say b) Silence is golden c) Words are more powerful than actions d) Actions are always loud

79. Neither the teacher nor the students …… present.
a) is b) were c) has been d) was

80. The phrase 'in the nick of time' means:
a) At the very last possible moment b) In the near future c) At the beginning d) Too late

81. Identify the correctly punctuated sentence:
a) Although it was raining we, went for a walk. b) Although it was raining, we went for a walk. c) Although, it was raining we went for a walk. d) Although it was, raining we went for a walk.

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:
a) Education, healthcare, and employment b) Agriculture c) None of the above d) Only entertainment

83. Which of the following is mentioned as a challenge of urbanization?
a) Low population b) Traffic congestion c) Abundant farmland d) Excess housing

84. What does the passage suggest is essential for livable cities?
a) Reducing population to zero b) Removing green spaces c) Sustainable urban planning d) Banning public transport

85. The passage is primarily about:
a) The history of cities b) Rural life c) Global warming d) The opportunities and challenges of urbanization

Section V: Logical Reasoning (1×15=15)

86. If the day before yesterday was Wednesday, what day will it be tomorrow?
a) Saturday b) Friday c) Monday d) Sunday

87. Fill in the blank: MBN NBO OBP PBQ _____
a) QBQ b) RBQ c) PBR d) QBR

88. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the son of c b) a is the brother of c c) a is the father of c d) a is the uncle of c

89. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) so b) Both a and b c) No conclusion d) since

90. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Grandfather b) Brother c) Father d) Uncle

91. Find the odd one out:
a) Carrot b) Apple c) Mango d) Banana

92. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) Some Lazzies are not Razzies b) All Lazzies are Bloops c) All Bloops are Lazzies d) No Bloops are Lazzies

93. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?
a) Painting Found Stolen by a Tree b) Tree Found Stolen Painting c) Tree Stole a Painting d) Painting Found Near a Tree

94. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Cannot be determined b) Partially follows c) Does not follow d) Follows

95. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Both I and II follow b) Only conclusion II follows c) Only conclusion I follows d) Neither I nor II follows

96. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 84 b) 98 c) 112 d) 120

97. Choose the word that does NOT belong with the others:
a) Cube b) Triangle c) Circle d) Square

98. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 24 b) 20 c) 22 d) 18

99. Find the next term: 1, 4, 9, 16, 25, ___
a) 36 b) 49 c) 30 d) 32

100. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 63 b) 62 c) 61 d) 64

Answer Key — Set 6

1	2	3	4	5	6	7	8	9	10
c	d	b	d	b	d	d	c	b	b
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	d	c	b	a	c	c	b	d	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	d	d	b	a	d	d	a	d	d
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
c	d	b	c	c	a	c	c	b	a
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	d	d	b	a	b	d	c	a	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	d	b	c	d	c	a	d	c	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b	d	a	d	b	b	c	a	b	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
b	d	b	c	c	c	a	a	b	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	a	b	c	d	a	d	d	a	c

91	92	93	94	95	96	97	98	99	100
a	c	d	d	c	c	a	b	a	a

PRACTICE SET 7

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cosh3x + B sinh3x b) A cos3x + B sin3x c) A e^{3x} + B e^{-3x} d) A e^{9x} + B e^{-9x}

2. The nullity of a 4×4 identity matrix is:
a) 1 b) 4 c) 0 d) Undefined

3. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) −4e^(2x) b) e^(2x) c) 0 d) 4e^(2x)

4. The derivative of ln(sin x) is:
a) tan x b) sec x c) cot x d) −cot x

5. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) 1 b) e c) ln 2 d) It diverges

6. The general solution of dy/dx = y/x is:
a) y = C/x b) y = Ce^x c) y = Cx^2 d) y = Cx

7. The Laplace transform of sinh(3t) is:
a) $s/(s^2-9)$ b) $3/(s^2-9)$ c) $3/(s^2+9)$ d) $s/(s^2+9)$

8. Which of the following statements is true?
a) Every sequence has a limit b) Every bounded sequence is convergent c) Every monotonic sequence converges
d) Every convergent sequence is bounded

9. The locus of the equation xz + yz = 0 is:
a) A pair of perpendicular planes b) A straight line c) A single plane d) A pair of parallel planes

10. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) −1, −1 b) 1, 1 c) 0, 0 d) 1, −1

11. The slope of the tangent at the origin for the curve y = sin x + x^2 is:
a) 1 b) 2 c) -1 d) 0

12. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) III only c) I and III only d) II only

13. The value of $\int_0^{\pi}$ sin x dx is:
a) 2 b) π c) 1 d) 0

14. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Supremum b) Infimum c) Minimum d) Maximum

15. The series Σ 1/(n ln n), n ≥ 2, is:
a) Oscillatory b) Conditionally convergent c) Convergent d) Divergent

16. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/√34 b) 3/√34 c) 5/34 d) 4/√34

17. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Orthogonal b) Symmetric c) Singular d) Invertible

18. The value of $\int e^x \cos x\, dx$ is:
a) $e^x \cos x + C$ b) $(e^x/2)(\sin x - \cos x) + C$ c) $(e^x/2)(\sin x + \cos x) + C$ d) $e^x \sin x + C$

19. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 25 b) 5 c) 120 d) 3125

20. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 0 b) 2 c) 1 d) 3

21. The Wronskian of two linearly dependent functions is:
a) Undefined b) 1 c) −1 d) 0

22. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3^n is:
a) $3(2/3)^5$ b) $6(2/3)^5$ c) $2(2/3)^5$ d) $6(2/3)^4$

23. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) ∞ b) 0 c) e d) 1

24. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(2,1), v=(1,2) b) u=(1,−1), v=(1,1) c) u=(1,1), v=(1,1) d) u=(1,1), v=(3,−1)

25. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) e b) 0 c) ∞ d) 1

Section II: Statistics (1×25=25)

26. The coefficient of determination R^2 measures:
a) None of the above b) The total unexplained variation in the model c) The proportion of variation in the independent variable explained by the dependent variable d) The proportion of variation in the dependent variable explained by the independent variable

27. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 60 b) 10 c) 15 d) 125

28. In hypothesis testing, a Type II error occurs when we:
a) Reject H_0 when H_0 is true b) Reject H_1 when H_1 is true c) Accept H_0 when H_0 is false d) None of the above

29. The variance of a constant c is:
a) c b) 0 c) c^2 d) Undefined

30. A Type I error is also known as:
a) Alpha error (false positive) b) Standard error c) Beta error d) Sampling error

31. The probability of an impossible event is:
a) Undefined b) 0.5 c) 0 d) 1

32. The chi-square test statistic can never be:
a) Positive b) Zero c) Negative d) A decimal value

33. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Positive b) Negative c) Unity d) Zero

34. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_x(0.5)^n$ b) ${}_nC_x(0.5)^x$ c) ${}_nC_x(0.5)^{(n-x)}$ d) ${}_nC_n(0.5)^x$

35. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 5/8 b) 1/2 c) 3/8 d) 1/8

36. The p-value in hypothesis testing represents:
a) The probability that H_0 is true b) The probability of observing the data (or more extreme), given H_0 is true c) The probability that H_1 is true d) The significance level itself

37. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ^2 and λ b) λ and λ^2 c) λ and λ d) $1/\lambda$ and $1/\lambda^2$

38. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mode b) Median c) None of the above d) Mean

39. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Kurtosis of X b) Variance of X c) Mean of X d) Skewness of X

40. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.3 b) 0.1 c) −0.2 d) 0.2

41. The best fitted trend line is the one for which the sum of squares of errors is:
a) Zero b) Maximum c) Minimum d) Negative

42. Which distribution is used for testing the equality of two population variances?
a) t-distribution b) Normal distribution c) F-distribution d) Chi-square distribution

43. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) The same width c) Cannot be determined d) Wider

44. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) \cdot P(B)$ b) $P(A) + P(B)$ c) $P(A)/P(B)$ d) $P(A) - P(B)$

45. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Central Limit Theorem b) Bayes' Theorem c) Chebyshev's Inequality d) Law of Large Numbers

46. The coefficient of variation is computed using the formula:
a) (s.d./mean) × 100 b) (mean × s.d.)/100 c) (mean/s.d.) × 100 d) 100/(mean × s.d.)

47. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15 b) 16 c) 15.5 d) 23

48. The appropriate statistical test for comparing means across more than two independent groups is:
a) Z-test b) F-test (ANOVA) c) t-test d) Chi-square test

49. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sigma$ b) $Z = (a-\mu)/\sqrt{n}$ c) $Z = (a-\mu)/\sigma^2$ d) $Z = (a-\mu)\sigma$

50. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c b) rc c) r + c − 2 d) (r−1)(c−1)

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following statements is executed by the preprocessor?
a) printf("Hello"); b) #define PI 3.14 c) return 0; d) void main()

52. Which system development approach is best suited when requirements evolve continuously?
a) None of the above b) Waterfall c) Agile d) V-model

53. A deadlock in an operating system occurs when:
a) A process uses too much CPU b) A process completes execution c) Two or more processes wait indefinitely for resources held by each other d) None of the above

54. A primary key can contain:
a) Neither duplicate nor NULL values b) NULL values c) Duplicate values d) Only NULL values

55. The time complexity of binary search on a sorted array of n elements is:
a) O(n) b) O(1) c) O(n log n) d) O(log n)

56. Which software is most commonly used for spreadsheet-based data analysis?
a) SPSS b) Photoshop c) MS Excel d) MS Paint

57. Which of the following is the most common metric for measuring algorithm efficiency?

a) Lines of code b) Time complexity (Big-O) c) Memory size d) Programming language used

58. Which of the following is not a Database Management System?
a) Windows b) MySQL c) PostgreSQL d) Oracle

59. IP in the context of networking stands for:
a) Internal Process b) Information Packet c) Interface Path d) Internet Protocol

60. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1.1 c) 192.168.1.1.1 d) 192.168.1

61. Which SDLC phase focuses on gathering and documenting user requirements?
a) Design b) Maintenance c) Testing d) Requirement Analysis

62. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 4 b) 5 c) 6 d) 10

63. Which protocol is used to send email?
a) FTP b) SMTP c) SNMP d) HTTP

64. Which of the following statements is true regarding relational database keys?
a) A relation can have only one foreign key b) A relation can have only one primary key c) A relation can have only one candidate key d) A relation can have multiple candidate keys

65. Which class of language is recognized by a pushdown automaton?
a) Context-sensitive language b) Regular language c) Recursively enumerable language d) Context-free language

66. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.0 b) 255.255.255.128 c) 255.255.255.192 d) 255.255.255.224

67. Which layer is responsible for routing data across different networks?
a) Application layer b) Network/Internet layer c) Physical layer d) Data link layer

68. Which of the following is an example of secondary memory?
a) Hard disk b) RAM c) Cache d) Register

69. Which sorting algorithm has the best average-case time complexity among the following?
a) Selection sort b) Quick sort c) Bubble sort d) Insertion sort

70. A firewall is primarily used to:
a) Speed up an internet connection b) Store data backups c) Compress files d) Control and filter network traffic for security

71. After a rollback, a transaction is in _____ state.
a) Committed b) Active c) Partially committed d) Aborted

72. Which of the following is used to uniquely identify a device on a network?
a) URL b) MAC address c) Domain name d) HTML tag

73. Which of the following is a NoSQL database?
a) MySQL b) MongoDB c) Oracle d) PostgreSQL

74. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) REMOVE c) DELETE d) TRUNCATE

75. Which of the following is an example of supervised learning?
a) K-means clustering b) Linear regression c) Principal Component Analysis d) Association rule mining

Section IV: Technical English (1×10=10)

76. Which of the following is a compound sentence?

a) Singing well is her passion. b) She sings well, and she dances gracefully. c) She sings well. d) Because she practices, she sings well.

77. "The thief was caught red-handed by the police." This means:

a) The thief's hands were painted red b) The police painted the thief's hand c) The thief was injured d) The thief was caught while committing the crime

78. Choose the correctly spelled word:

a) Receiv b) Receive c) Receve d) Recieve

79. Choose the correct form: 'One of the students _____ absent today.'

a) have been b) were c) are d) is

80. The synonym of 'abundant' is:

a) Rare b) Scarce c) Limited d) Plentiful

81. He asked me ……

a) that where do I live b) where I lived c) that where I lived d) where I will live

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:

a) Governments dislike renewable energy b) Wind energy is the only alternative c) Renewable energy is gaining importance due to environmental benefits d) Fossil fuels are better than renewables

83. The mode of approach in the passage is:

a) Poetic b) Argumentative c) Descriptive d) Narrative

84. According to the passage, one benefit of renewable energy is:

a) Limited availability b) Low greenhouse gas emissions c) Requiring fossil fuel input d) High cost

85. The most appropriate title for the passage is:

a) Climate Change Effects b) The Decline of Fossil Fuels c) Renewable Energy: A Sustainable Future d) Solar Power Only

Section V: Logical Reasoning (1×15=15)

86. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 36 b) 40 c) 42 d) 44

87. All cats are animals. No animal is a plant. Therefore:

a) No cat is a plant b) Some cats are plants c) No conclusion can be drawn d) All plants are animals

88. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 20 b) 18 c) 22 d) 24

89. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) Some Lazzies are not Razzies b) No Bloops are Lazzies c) All Bloops are Lazzies d) All Lazzies are Bloops

90. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UBCLF b) UACMF c) TBCMF d) UBCMF

91. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.

Conclusion II: All erasers are pencils.

Which one is true?

a) Neither I nor II follows b) Only conclusion I follows c) Both I and II follow d) Only conclusion II follows

92. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 61 b) 63 c) 64 d) 62

93. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?
a) EPH b) EPG c) DPH d) EOH

94. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Both I and II follow b) Only conclusion I follows c) Only conclusion II follows d) Neither I nor II follows

95. Find the odd one out:
a) Apple b) Banana c) Mango d) Carrot

96. Choose the word that does NOT belong with the others:
a) Square b) Cube c) Circle d) Triangle

97. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 112 b) 98 c) 84 d) 120

98. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Neither I nor II follows b) Only conclusion II follows c) Both I and II follow d) Only conclusion I follows

99. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?
a) Painting Found Stolen by a Tree b) Painting Found Near a Tree c) Tree Found Stolen Painting d) Tree Stole a Painting

100. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Father b) Brother c) Uncle d) Grandfather

Answer Key — Set 7

1	2	3	4	5	6	7	8	9	10
c	c	c	c	c	d	b	d	a	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	c	a	b	d	a	c	c	c	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
d	b	c	d	c	d	d	c	b	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
c	c	a	a	c	b	c	d	b	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	c	d	a	a	a	c	b	a	d
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	c	c	a	d	c	b	a	d	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	b	b	d	d	c	b	a	b	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	b	b	a	b	b	d	b	d	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	c	c	b	c	c	a	a	c	d
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
b	b	a	b	d	b	a	d	b	a

PRACTICE SET 8

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The value of lim (x→0) (sin x)/x is:
a) 1 b) ∞ c) 0 d) Undefined

2. A square matrix A is called orthogonal if:
a) $A = A^T$ b) $A\,A^T = I$ c) $\det(A) = 0$ d) $A^2 = I$

3. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $x\,e^x/2$ b) e^x c) $e^x/2$ d) $x^2\,e^x$

4. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one and onto b) One-one but not onto c) Onto but not one-one d) Neither one-one nor onto

5. Curl of the gradient of a scalar function is always:
a) Undefined b) Unity c) Equal to its divergence d) Zero

6. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) ∞ b) 1 c) 0 d) e

7. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) 1 b) ∞ c) 0 d) e

8. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 3 b) 0 c) 1 d) 2

9. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) An even function b) Differentiable at x = 0 c) Continuous but not differentiable at x = 0 d) Discontinuous at x = 0

10. The value of lim (x→0) (sin x)/x is:
a) Undefined b) 1 c) 0 d) ∞

11. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) III only b) I only c) II only d) I and III only

12. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one but not onto b) One-one and onto c) Neither one-one nor onto d) Onto but not one-one

13. A square matrix A is called orthogonal if:
a) $\det(A) = 0$ b) $A\,A^T = I$ c) $A^2 = I$ d) $A = A^T$

14. A continuous function on a closed and bounded interval [a, b] is always:
a) Monotonic on [a, b] b) Unbounded on [a, b] c) Differentiable on [a, b] d) Uniformly continuous on [a, b]

15. The value of $\int e^x \cos x\, dx$ is:
a) $e^x \sin x + C$ b) $(e^x/2)(\sin x + \cos x) + C$ c) $e^x \cos x + C$ d) $(e^x/2)(\sin x - \cos x) + C$

16. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 0, 0 b) 1, 1 c) −1, −1 d) 1, −1

17. Which of the following statements is true?
a) Every convergent sequence is bounded b) Every bounded sequence is convergent c) Every sequence has a limit d) Every monotonic sequence converges

18. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 3/4 b) 6 c) 4/3 d) 9

19. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 3 b) 2 c) 0 d) 1

20. The Laplace transform of sinh(3t) is:
a) $s/(s^2+9)$ b) $3/(s^2-9)$ c) $3/(s^2+9)$ d) $s/(s^2-9)$

21. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) $\pi/4$ b) π c) 1 d) $\pi/2$

22. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 3 b) 1 c) 2 d) 0

23. The particular integral of $(D^2 - 1)y = e^x$ is:
a) e^x b) $x^2 e^x$ c) $e^x/2$ d) $x\,e^x/2$

24. Curl of the gradient of a scalar function is always:
a) Undefined b) Equal to its divergence c) Zero d) Unity

25. The general solution of $dy/dx = y/x$ is:
a) $y = C/x$ b) $y = Ce^x$ c) $y = Cx^2$ d) $y = Cx$

Section II: Statistics (1×25=25)

26. If the two observations are 15 and −15, then their harmonic mean is:
a) −15 b) 0 c) 15 d) ∞ (undefined)

27. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) Two-tailed test b) None of the above c) One-sided lower-tailed test d) One-sided upper-tailed test

28. In simple random sampling without replacement from a finite population, each unit has:
a) A probability depending on order drawn b) An equal probability of selection c) An unequal probability of selection d) Zero probability of selection

29. The correlation coefficient r always lies between:
a) 0 and 1 b) −∞ and ∞ c) −1 and 1 d) 0 and ∞

30. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 3 b) 6 c) 5 d) 4

31. The best fitted trend line is the one for which the sum of squares of errors is:
a) Zero b) Negative c) Maximum d) Minimum

32. For a Poisson distribution, which of the following is true?
a) None of the above b) Mean > Variance c) Mean = Variance d) Mean < Variance

33. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 6 b) 4 c) 3 d) 5

34. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 10 b) 125 c) 60 d) 15

35. The coefficient of determination R^2 measures:
a) None of the above b) The proportion of variation in the dependent variable explained by the independent variable c) The proportion of variation in the independent variable explained by the dependent variable d) The total unexplained variation in the model

36. The coefficient of variation is computed using the formula:
a) 100/(mean × s.d.) b) (mean/s.d.) × 100 c) (mean × s.d.)/100 d) (s.d./mean) × 100

37. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The variance c) The population mean d) The expected number of successes in the sample

38. If the two observations are 15 and −15, then their harmonic mean is:
a) 15 b) 0 c) −15 d) ∞ (undefined)

39. The p-value in hypothesis testing represents:
a) The probability of observing the data (or more extreme), given H_0 is true b) The significance level itself c) The probability that H_0 is true d) The probability that H_1 is true

40. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c − 2 b) (r−1)(c−1) c) rc d) r + c

41. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Negative c) Positive d) Zero

42. The probability of an impossible event is:
a) 1 b) 0 c) 0.5 d) Undefined

43. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Cannot be determined b) Narrower c) The same width d) Wider

44. Which measure of central tendency is most affected by extreme values (outliers)?
a) None of the above b) Mean c) Median d) Mode

45. The variance of a constant c is:
a) c^2 b) c c) Undefined d) 0

46. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 1/2 c) 1/8 d) 5/8

47. The binomial distribution tends to the normal distribution when:
a) $n \to 0$ b) $p \to 0$, $n \to \infty$, np fixed c) $n \to \infty$, p fixed d) $np \to \lambda$ (finite)

48. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 9 b) 13 c) 4 d) 2

49. The geometric mean of 2, 4, and 8 is:
a) 4 b) 4.67 c) 5 d) 8

50. In hypothesis testing, a Type II error occurs when we:
a) None of the above b) Reject H_0 when H_0 is true c) Accept H_0 when H_0 is false d) Reject H_1 when H_1 is true

Section III: Computer Science and Information Technology (1×25=25)

51. Which normal form removes partial dependency on a composite primary key?
a) 3NF b) BCNF c) 2NF d) 1NF

52. The result of $(11010)_2 - (1011)_2$ is:
a) 11100 b) 01110 c) 01111 d) 10101

53. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) SELECT, FROM, WHERE c) FROM, SELECT, WHERE d) WHERE, SELECT, FROM

54. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 2NF b) 4NF c) 1NF d) BCNF

55. Which of the following is a compiled language?
a) C b) PHP c) JavaScript d) Python

56. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Lines of code c) Time complexity (Big-O) d) Memory size

57. A firewall is primarily used to:

a) Store data backups b) Compress files c) Control and filter network traffic for security d) Speed up an internet connection

58. Which SDLC phase focuses on gathering and documenting user requirements?
a) Requirement Analysis b) Testing c) Maintenance d) Design

59. The OSI model has how many layers?
a) 7 b) 8 c) 6 d) 5

60. Which of the following is an example of secondary memory?
a) Cache b) Hard disk c) RAM d) Register

61. After a rollback, a transaction is in _____ state.
a) Aborted b) Partially committed c) Committed d) Active

62. The result of $(11010)_2 - (1011)_2$ is:
a) 10101 b) 11100 c) 01111 d) 01110

63. Which of the following statements is executed by the preprocessor?
a) printf("Hello"); b) #define PI 3.14 c) return 0; d) void main()

64. Which of the following is a valid IPv4 address?
a) 192.168.1 b) 192.168.1.256 c) 192.168.1.1 d) 192.168.1.1.1

65. Which of the following information is required to normalize a relation into 3NF?
a) Join dependency b) Functional dependency c) None of the above d) Multivalued dependency

66. Which of the following is an example of supervised learning?
a) Principal Component Analysis b) Linear regression c) Association rule mining d) K-means clustering

67. Which system development approach is best suited when requirements evolve continuously?
a) None of the above b) V-model c) Waterfall d) Agile

68. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Inheritance b) Polymorphism c) Abstraction d) Encapsulation

69. A primary key can contain:
a) Neither duplicate nor NULL values b) NULL values c) Only NULL values d) Duplicate values

70. Which data structure works on the LIFO (Last In First Out) principle?
a) Queue b) Linked list c) Stack d) Array

71. A deadlock in an operating system occurs when:
a) A process uses too much CPU b) A process completes execution c) None of the above d) Two or more processes wait indefinitely for resources held by each other

72. Which of the following statements is true regarding relational database keys?
a) A relation can have only one foreign key b) A relation can have only one primary key c) A relation can have multiple candidate keys d) A relation can have only one candidate key

73. Which normal form removes partial dependency on a composite primary key?
a) 2NF b) 3NF c) 1NF d) BCNF

74. Which of the following is a NoSQL database?
a) MongoDB b) MySQL c) PostgreSQL d) Oracle

75. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 5 b) 6 c) 10 d) 4

Section IV: Technical English (1×10=10)

76. Neither the teacher nor the students …… present.

a) was b) were c) is d) has been

77. The idiom 'to hit the nail on the head' means:
a) To say or do something exactly right b) To hurt someone c) To make a mistake d) To work with tools

78. The antonym of 'diligent' is:
a) Careful b) Lazy c) Hardworking d) Punctual

79. Choose the correctly punctuated sentence:
a) It's a nice day b) It is'nt a nice day c) Its' a nice day d) Its a nice day

80. 'He is used to _____ early.'
a) woke b) waken c) wake d) waking

81. "He is the black sheep of the family." The underlined expression has …… meaning.
a) Literal b) Figurative c) Contextual d) Poetic

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:
a) Job displacement and data privacy b) AI is too expensive c) AI cannot analyze data d) AI is only used in healthcare

83. According to the passage, what do experts recommend?
a) Banning AI completely b) Ignoring privacy concerns c) A balanced approach combining innovation and ethical safeguards d) Using AI only in finance

84. The tone of the passage is:
a) Purely critical b) Purely promotional c) Balanced and analytical d) Sarcastic

85. The most suitable title for the passage is:
a) Healthcare Systems Today b) Artificial Intelligence: Opportunities and Challenges c) The Dangers of Technology d) Finance in the Modern Age

Section V: Logical Reasoning (1×15=15)

86. Which of the following is NOT a useful principle for making scientific progress?
a) Actively seek disconfirming evidence as well b) Divide the problem into manageable components c) Compare similar cases to isolate the relevant difference d) Look only for confirming evidence and ignore disconfirming evidence

87. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) bota b) winbo c) ligowin d) bowin

88. Find the next term: 1, 4, 9, 16, 25, ___
a) 36 b) 30 c) 49 d) 32

89. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the son of c b) a is the brother of c c) a is the father of c d) a is the uncle of c

90. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Follows b) Cannot be determined c) Partially follows d) Does not follow

91. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) The Earth revolves around the Sun b) He scored the highest marks in class c) Could you please close the door? d) Water boils at 100°C at sea level

92. Fill in the blank: MBN NBO OBP PBQ _____
a) QBR b) PBR c) QBQ d) RBQ

93. If the day before yesterday was Wednesday, what day will it be tomorrow?
a) Saturday b) Friday c) Sunday d) Monday

94. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?
a) Daughter b) Sister c) Mother d) Aunt

95. Circle is to Sphere as Square is to:
a) Cylinder b) Cone c) Rectangle d) Cube

96. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 24 b) 22 c) 20 d) 18

97. Find the missing number: 2, 5, 10, 17, 26, ___
a) 37 b) 35 c) 36 d) 38

98. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."
a) since b) so c) No conclusion d) Both a and b

99. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) I, II, and III b) None of the statements is true c) II only d) II and III only

100. Look at the series: 5, 9, 17, 33, ___. What number should come next?
a) 65 b) 61 c) 63 d) 67

Answer Key — Set 8

1	2	3	4	5	6	7	8	9	10
a	b	a	b	d	d	b	d	c	b
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
d	a	b	d	b	d	a	a	b	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	a	d	c	d	d	d	b	c	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	c	d	b	b	d	d	d	a	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	b	d	b	d	a	c	d	a	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	c	a	d	a	c	c	a	a	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
a	c	b	c	b	b	d	a	a	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	c	a	a	a	b	a	b	a	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	a	c	c	b	d	d	a	d	a
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**

c	a	a	b	d	c	a	b	d	a

PRACTICE SET 9

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The nullity of a 4×4 identity matrix is:
a) 1 b) 0 c) Undefined d) 4

2. Which of the following sets is countable?
a) Real numbers b) Rational numbers c) The interval [0, 1] d) Irrational numbers

3. The locus of the equation xz + yz = 0 is:
a) A pair of parallel planes b) A straight line c) A single plane d) A pair of perpendicular planes

4. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Minimum c) Supremum d) Infimum

5. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 4/√34 b) 5/34 c) 3/√34 d) 5/√34

6. The value of ∫₀^π sin x dx is:
a) 0 b) 2 c) π d) 1

7. Which of the following is an even function?
a) x b) x^3 c) sin x d) cos x

8. The curve y = x^(1/3) at (0, 0) has:
a) An oblique tangent b) A horizontal tangent c) A vertical tangent d) No tangent

9. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 6, 0 c) 4, 2 d) 3, 3

10. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 0 b) 2 c) 1 d) -1

11. The determinant of a triangular matrix equals:
a) The product of its diagonal elements b) The sum of its diagonal elements c) Zero always d) The square of its trace

12. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Symmetric b) Invertible c) Orthogonal d) Singular

13. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 27 b) 3 c) 9 d) 1

14. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) y = A + Bx b) $y = Ae^x + Be^{-x}$ c) y = A cos x + B sin x d) $y = Ae^{ix}$

15. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3ⁿ is:
a) $2(2/3)^5$ b) $6(2/3)^5$ c) $6(2/3)^4$ d) $3(2/3)^5$

16. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cos3x + B sin3x b) A cosh3x + B sinh3x c) $A e^{9x} + B e^{-9x}$ d) $A e^{3x} + B e^{-3x}$

17. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,−1), v=(1,1) b) u=(1,1), v=(3,−1) c) u=(2,1), v=(1,2) d) u=(1,1), v=(1,1)

18. The derivative of ln(sin x) is:
a) tan x b) sec x c) cot x d) −cot x

19. If y = e^(2x), then the value of y'' − 4y' + 4y is:

a) 0 b) 4e^(2x) c) −4e^(2x) d) e^(2x)

20. The Wronskian of two linearly dependent functions is:
a) −1 b) 0 c) 1 d) Undefined

21. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) ln 2 b) e c) 1 d) It diverges

22. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 5 b) 120 c) 3125 d) 25

23. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) 1/x b) ln x c) x d) x^2

24. A monotonic decreasing bounded sequence converges to its:
a) Infimum b) Supremum c) Maximum d) Upper bound

25. The series $\Sigma\ 1/(n \ln n)$, $n \geq 2$, is:
a) Conditionally convergent b) Oscillatory c) Convergent d) Divergent

Section II: Statistics (1×25=25)

26. If two events A and B are independent, then $P(A \cap B)$ equals:
a) P(A)/P(B) b) P(A) + P(B) c) P(A) − P(B) d) P(A)·P(B)

27. The statistical test generally used to test association between two independent categorical variables is:
a) t-test b) Z-test c) F-test d) Chi-square test

28. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) t-test c) Chi-square test d) Z-test

29. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.1 b) 0.3 c) −0.2 d) 0.2

30. The chi-square test statistic can never be:
a) Negative b) Zero c) Positive d) A decimal value

31. Which distribution is used for testing the equality of two population variances?
a) t-distribution b) F-distribution c) Chi-square distribution d) Normal distribution

32. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_x(0.5)^{(n-x)}$ b) ${}_nC_x(0.5)^x$ c) ${}_nC_n(0.5)^x$ d) ${}_nC_x(0.5)^n$

33. The correlation coefficient r always lies between:
a) −1 and 1 b) 0 and 1 c) 0 and ∞ d) −∞ and ∞

34. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Least squares method b) Free-hand curve method c) Semi-average method d) Moving average method

35. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) (n+1)/2 b) $n^2/2$ c) n/2 d) (n−1)/2

36. In simple random sampling without replacement from a finite population, each unit has:
a) Zero probability of selection b) An equal probability of selection c) A probability depending on order drawn d) An unequal probability of selection

37. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sigma^2$ b) $Z = (a-\mu)/\sigma$ c) $Z = (a-\mu)\sigma$ d) $Z = (a-\mu)/\sqrt{n}$

38. If the correlation coefficient r = 0 between X and Y, it implies:
a) No linear relationship between X and Y b) A negative relationship between X and Y c) No relationship at all between X and Y d) A perfect relationship between X and Y

39. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ and λ b) λ^2 and λ c) $1/\lambda$ and $1/\lambda^2$ d) λ and λ^2

40. A Type I error is also known as:
a) Alpha error (false positive) b) Sampling error c) Beta error d) Standard error

41. In stratified sampling, the population is divided into:
a) Equal-sized random groups b) Systematic intervals c) Homogeneous subgroups (strata) d) Random clusters

42. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Variance of X b) Kurtosis of X c) Skewness of X d) Mean of X

43. The standard normal distribution has mean and variance:
a) 1 and 1 b) 0 and 0 c) 0 and 1 d) 1 and 0

44. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) Two-tailed test b) None of the above c) One-sided lower-tailed test d) One-sided upper-tailed test

45. The sum of squares of deviations is minimum when measured from the:
a) Mean b) Mode c) Median d) Geometric mean

46. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Harmonic mean b) Arithmetic mean c) Geometric mean d) Median

47. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Central Limit Theorem b) Bayes' Theorem c) Chebyshev's Inequality d) Law of Large Numbers

48. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$ b) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ c) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$

49. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 16 b) 15 c) 15.5 d) 23

50. The standard deviation of a distribution is always:
a) Negative b) Zero c) Non-negative d) Undefined

Section III: Computer Science and Information Technology (1×25=25)

51. The ability of objects to take on multiple forms is called:
a) Abstraction b) Polymorphism c) Encapsulation d) Inheritance

52. IP in the context of networking stands for:
a) Interface Path b) Internal Process c) Internet Protocol d) Information Packet

53. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Paint b) SPSS c) MS Excel d) Photoshop

54. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.224 b) 255.255.255.128 c) 255.255.255.0 d) 255.255.255.192

55. Which of the following best describes cloud computing?
a) Storing data only on local computers b) A hardware component c) Delivering computing services (storage, servers, software) over the internet d) A type of programming language

56. Which switching technique requires a dedicated path between sender and receiver?
a) Message switching b) None of the above c) Circuit switching d) Packet switching

57. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) SELECT, FROM, WHERE b) FROM, SELECT, WHERE c) FROM, WHERE, SELECT d) WHERE, SELECT, FROM

58. Which of the following is a compiled language?
a) C b) PHP c) JavaScript d) Python

59. Which of the following is used to uniquely identify a device on a network?
a) MAC address b) HTML tag c) URL d) Domain name

60. Which protocol is used to send email?
a) SNMP b) FTP c) SMTP d) HTTP

61. Which layer is responsible for routing data across different networks?
a) Data link layer b) Network/Internet layer c) Application layer d) Physical layer

62. Which class of language is recognized by a pushdown automaton?
a) Regular language b) Context-sensitive language c) Context-free language d) Recursively enumerable language

63. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) TRUNCATE c) DROP d) DELETE

64. The time complexity of binary search on a sorted array of n elements is:
a) O(log n) b) O(1) c) O(n) d) O(n log n)

65. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Queue c) Tree d) Stack

66. Which diagram is used to represent the flow of data in structured software analysis?
a) Data Flow Diagram (DFD) b) Use-case diagram c) Entity Relationship diagram d) Class diagram

67. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 1NF b) 4NF c) BCNF d) 2NF

68. In machine learning, overfitting refers to a model that:
a) Performs equally well on all datasets b) Performs well on training data but poorly on new/unseen data c) Cannot be trained at all d) Performs poorly on training data

69. Round-robin scheduling is the preemptive version of:
a) None of the above b) Shortest Job First c) First Come First Serve (FCFS) d) Priority Scheduling

70. Recursion in programming is best described as:
a) A loop with no exit condition b) A function that never returns c) A function calling itself to solve smaller instances of a problem d) A data structure

71. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Bubble sort c) Quick sort d) Selection sort

72. Which of the following is not a Database Management System?
a) Oracle b) Windows c) MySQL d) PostgreSQL

73. Which of the following is an entry-controlled loop?
a) Both while and do-while b) do-while c) while d) None of the above

74. HTTP stands for:
a) HyperText Transfer Protocol b) High Transfer Text Protocol c) Host Transfer Text Protocol d) HyperText Transmission Process

75. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Persistence c) Refresh rate d) Fluorescence

Section IV: Technical English (1×10=10)

76. Choose the correct passive voice of 'She is writing a letter.'

a) A letter is written by her b) A letter is being written by her c) A letter has been written by her d) A letter was being written by her

77. "The thief was caught red-handed by the police." This means:

a) The thief's hands were painted red b) The thief was injured c) The police painted the thief's hand d) The thief was caught while committing the crime

78. Choose the correctly spelled word:

a) Receve b) Receive c) Recieve d) Receiv

79. "She always works diligently." The part of speech of the underlined word 'diligently' is:

a) Adjective b) Noun c) Adverb d) Verb

80. Choose the correct form: 'One of the students _____ absent today.'

a) were b) is c) are d) have been

81. Choose the word closest in meaning to 'meticulous':

a) Careful and precise b) Careless c) Quick d) Confused

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:

a) Agriculture b) Only entertainment c) Education, healthcare, and employment d) None of the above

83. Which of the following is mentioned as a challenge of urbanization?

a) Excess housing b) Low population c) Traffic congestion d) Abundant farmland

84. What does the passage suggest is essential for livable cities?

a) Removing green spaces b) Sustainable urban planning c) Banning public transport d) Reducing population to zero

85. The passage is primarily about:

a) The history of cities b) Rural life c) The opportunities and challenges of urbanization d) Global warming

Section V: Logical Reasoning (1×15=15)

86. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) He scored the highest marks in class b) The Earth revolves around the Sun c) Water boils at 100°C at sea level d) Could you please close the door?

87. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Grandfather b) Father c) Uncle d) Brother

88. Choose the word that does NOT belong with the others:

a) Cube b) Square c) Circle d) Triangle

89. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 61 b) 63 c) 64 d) 62

90. Find the odd one out:

a) Banana b) Mango c) Apple d) Carrot

91. All cats are animals. No animal is a plant. Therefore:

a) No conclusion can be drawn b) No cat is a plant c) All plants are animals d) Some cats are plants

92. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) since b) No conclusion c) so d) Both a and b

93. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) I, II, and III b) None of the statements is true c) II and III only d) II only

94. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 22 b) 20 c) 18 d) 24

95. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) All Bloops are Lazzies b) No Bloops are Lazzies c) Some Lazzies are not Razzies d) All Lazzies are Bloops

96. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 18 b) 20 c) 24 d) 22

97. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 36 b) 42 c) 44 d) 40

98. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Only conclusion II follows b) Only conclusion I follows c) Neither I nor II follows d) Both I and II follow

99. Find the missing number: 2, 5, 10, 17, 26, ___
a) 35 b) 38 c) 36 d) 37

100. Which of the following is NOT a useful principle for making scientific progress?
a) Divide the problem into manageable components b) Look only for confirming evidence and ignore disconfirming evidence c) Compare similar cases to isolate the relevant difference d) Actively seek disconfirming evidence as well

Answer Key — Set 9

1	2	3	4	5	6	7	8	9	10
b	b	d	d	d	b	d	c	c	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	d	b	c	b	d	b	c	a	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	b	c	a	d	d	d	a	d	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	d	a	a	a	b	b	a	a	a
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	c	d	a	c	a	c	c	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	c	c	d	c	c	c	a	a	c
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b	c	c	a	b	a	c	b	c	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	b	c	a	d	b	d	b	c	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	c	c	b	c	d	b	a	b	d
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
b	c	c	b	a	b	b	b	d	b

PRACTICE SET 10

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The value of $\int e^x \cos x \, dx$ is:
a) $(e^x/2)(\sin x - \cos x) + C$ b) $(e^x/2)(\sin x + \cos x) + C$ c) $e^x \sin x + C$ d) $e^x \cos x + C$

2. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) 1 b) ∞ c) e d) 0

3. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(3,−1) b) u=(1,−1), v=(1,1) c) u=(1,1), v=(1,1) d) u=(2,1), v=(1,2)

4. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 1 b) 0 c) 2 d) -1

5. A monotonic decreasing bounded sequence converges to its:
a) Infimum b) Supremum c) Upper bound d) Maximum

6. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 6, 0 c) 4, 2 d) 3, 3

7. Which of the following statements is true?
a) Every monotonic sequence converges b) Every convergent sequence is bounded c) Every bounded sequence is convergent d) Every sequence has a limit

8. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Differentiable at x = 0 b) An even function c) Discontinuous at x = 0 d) Continuous but not differentiable at x = 0

9. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $e^x/2$ b) $x\,e^x/2$ c) $x^2 e^x$ d) e^x

10. The derivative of ln(sin x) is:
a) tan x b) cot x c) −cot x d) sec x

11. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 2 b) 0 c) 3 d) 1

12. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 5 b) 120 c) 3125 d) 25

13. The value of ∫₀^π sin x dx is:
a) 0 b) 1 c) π d) 2

14. The locus of the equation xz + yz = 0 is:
a) A single plane b) A pair of perpendicular planes c) A straight line d) A pair of parallel planes

15. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 2 b) 1 c) 3 d) 0

16. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) 1 b) Undefined c) ∞ d) 0

17. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cos3x + B sin3x b) $A e^{9x} + B e^{-9x}$ c) A cosh3x + B sinh3x d) $A e^{3x} + B e^{-3x}$

18. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) An oblique tangent c) A vertical tangent d) A horizontal tangent

19. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:

a) 4/√34 b) 5/√34 c) 5/34 d) 3/√34

20. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Infimum b) Minimum c) Maximum d) Supremum

21. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 0, 0 b) −1, −1 c) 1, −1 d) 1, 1

22. The Wronskian of two linearly dependent functions is:
a) Undefined b) −1 c) 1 d) 0

23. The series Σ 1/(n ln n), n ≥ 2, is:
a) Conditionally convergent b) Convergent c) Oscillatory d) Divergent

24. A continuous function on a closed and bounded interval [a, b] is always:
a) Monotonic on [a, b] b) Uniformly continuous on [a, b] c) Unbounded on [a, b] d) Differentiable on [a, b]

25. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3^n is:
a) $6(2/3)^5$ b) $2(2/3)^5$ c) $6(2/3)^4$ d) $3(2/3)^5$

Section II: Statistics (1×25=25)

26. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Chebyshev's Inequality b) Bayes' Theorem c) Central Limit Theorem d) Law of Large Numbers

27. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c b) rc c) (r−1)(c−1) d) r + c − 2

28. The coefficient of variation is computed using the formula:
a) 100/(mean × s.d.) b) (s.d./mean) × 100 c) (mean × s.d.)/100 d) (mean/s.d.) × 100

29. In a binomial distribution, if the probability of success π = 0.5, then Pr(X=x) is given by:
a) $_nC_x(0.5)^{(n-x)}$ b) $_nC_x(0.5)^x$ c) $_nC_x(0.5)^n$ d) $_nC_n(0.5)^x$

30. For a Poisson distribution, which of the following is true?
a) Mean > Variance b) Mean = Variance c) None of the above d) Mean < Variance

31. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 4 b) 5 c) 6 d) 3

32. The correlation coefficient r always lies between:
a) −∞ and ∞ b) −1 and 1 c) 0 and ∞ d) 0 and 1

33. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Arithmetic mean b) Harmonic mean c) Median d) Geometric mean

34. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Free-hand curve method b) Least squares method c) Moving average method d) Semi-average method

35. The coefficient of determination R^2 measures:
a) None of the above b) The proportion of variation in the dependent variable explained by the independent variable c) The proportion of variation in the independent variable explained by the dependent variable d) The total unexplained variation in the model

36. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15 b) 23 c) 15.5 d) 16

37. The statistical test generally used to test association between two independent categorical variables is:
a) F-test b) t-test c) Z-test d) Chi-square test

38. The best fitted trend line is the one for which the sum of squares of errors is:

a) Minimum b) Zero c) Negative d) Maximum

39. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.2 b) −0.2 c) 0.1 d) 0.3

40. If the correlation coefficient r = 0 between X and Y, it implies:
a) No relationship at all between X and Y b) No linear relationship between X and Y c) A perfect relationship between X and Y d) A negative relationship between X and Y

41. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 1/8 c) 1/2 d) 5/8

42. In simple random sampling without replacement from a finite population, each unit has:
a) An equal probability of selection b) An unequal probability of selection c) A probability depending on order drawn d) Zero probability of selection

43. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Kurtosis of X b) Skewness of X c) Variance of X d) Mean of X

44. In hypothesis testing, a Type II error occurs when we:
a) None of the above b) Reject H_0 when H_0 is true c) Reject H_1 when H_1 is true d) Accept H_0 when H_0 is false

45. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 15 b) 60 c) 10 d) 125

46. In stratified sampling, the population is divided into:
a) Homogeneous subgroups (strata) b) Random clusters c) Equal-sized random groups d) Systematic intervals

47. The p-value in hypothesis testing represents:
a) The probability that H_1 is true b) The probability of observing the data (or more extreme), given H_0 is true c) The significance level itself d) The probability that H_0 is true

48. Which distribution is used for testing the equality of two population variances?
a) Normal distribution b) F-distribution c) Chi-square distribution d) t-distribution

49. The standard normal distribution has mean and variance:
a) 1 and 0 b) 1 and 1 c) 0 and 1 d) 0 and 0

50. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) \cdot P(B)$ b) $P(A)/P(B)$ c) $P(A) - P(B)$ d) $P(A) + P(B)$

Section III: Computer Science and Information Technology (1×25=25)

51. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Persistence c) Fluorescence d) Refresh rate

52. In machine learning, overfitting refers to a model that:
a) Performs well on training data but poorly on new/unseen data b) Cannot be trained at all c) Performs poorly on training data d) Performs equally well on all datasets

53. The time complexity of binary search on a sorted array of n elements is:
a) O(1) b) O(log n) c) O(n log n) d) O(n)

54. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) REMOVE c) TRUNCATE d) DELETE

55. A firewall is primarily used to:
a) Store data backups b) Speed up an internet connection c) Compress files d) Control and filter network traffic for security

56. What is the correct logical order of execution of clauses in an SQL SELECT query?

a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) SELECT, FROM, WHERE d) WHERE, SELECT, FROM

57. The result of $(11010)_2 - (1011)_2$ is:
a) 11100 b) 01111 c) 01110 d) 10101

58. After a rollback, a transaction is in _____ state.
a) Partially committed b) Active c) Committed d) Aborted

59. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 5 b) 4 c) 10 d) 6

60. Which protocol is used to send email?
a) FTP b) SNMP c) HTTP d) SMTP

61. Which of the following is an example of secondary memory?
a) RAM b) Cache c) Register d) Hard disk

62. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Memory size c) Lines of code d) Time complexity (Big-O)

63. IP in the context of networking stands for:
a) Interface Path b) Information Packet c) Internet Protocol d) Internal Process

64. Which of the following is an entry-controlled loop?
a) None of the above b) do-while c) Both while and do-while d) while

65. Which SDLC phase focuses on gathering and documenting user requirements?
a) Testing b) Requirement Analysis c) Design d) Maintenance

66. Which of the following statements is true regarding relational database keys?
a) A relation can have multiple candidate keys b) A relation can have only one foreign key c) A relation can have only one candidate key d) A relation can have only one primary key

67. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Encapsulation b) Polymorphism c) Abstraction d) Inheritance

68. Which of the following is an example of supervised learning?
a) K-means clustering b) Association rule mining c) Linear regression d) Principal Component Analysis

69. A deadlock in an operating system occurs when:
a) Two or more processes wait indefinitely for resources held by each other b) A process uses too much CPU c) None of the above d) A process completes execution

70. Which of the following best describes cloud computing?
a) A hardware component b) Storing data only on local computers c) A type of programming language d) Delivering computing services (storage, servers, software) over the internet

71. Which software is most commonly used for spreadsheet-based data analysis?
a) SPSS b) MS Excel c) MS Paint d) Photoshop

72. Round-robin scheduling is the preemptive version of:
a) Priority Scheduling b) First Come First Serve (FCFS) c) Shortest Job First d) None of the above

73. Which normal form removes partial dependency on a composite primary key?
a) 3NF b) 1NF c) BCNF d) 2NF

74. Which of the following is a compiled language?
a) PHP b) JavaScript c) Python d) C

75. Which system development approach is best suited when requirements evolve continuously?
a) Agile b) None of the above c) V-model d) Waterfall

Section IV: Technical English (1×10=10)

76. 'By the time we arrived, the movie _____.'
a) already started b) has already started c) had already started d) already starts

77. Which of the following is a compound sentence?
a) Singing well is her passion. b) Because she practices, she sings well. c) She sings well. d) She sings well, and she dances gracefully.

78. Choose the correct comparative form: 'This problem is _____ than the previous one.'
a) more difficult b) most difficult c) difficult d) difficultest

79. 'Actions speak louder than words' means:
a) Words are more powerful than actions b) What people do matters more than what they say c) Silence is golden d) Actions are always loud

80. The phrase 'in the nick of time' means:
a) Too late b) In the near future c) At the beginning d) At the very last possible moment

81. Identify the correctly punctuated sentence:
a) Although it was, raining we went for a walk. b) Although, it was raining we went for a walk. c) Although it was raining, we went for a walk. d) Although it was raining we, went for a walk.

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:
a) Governments dislike renewable energy b) Renewable energy is gaining importance due to environmental benefits c) Wind energy is the only alternative d) Fossil fuels are better than renewables

83. The mode of approach in the passage is:
a) Poetic b) Argumentative c) Narrative d) Descriptive

84. According to the passage, one benefit of renewable energy is:
a) Limited availability b) High cost c) Requiring fossil fuel input d) Low greenhouse gas emissions

85. The most appropriate title for the passage is:
a) The Decline of Fossil Fuels b) Climate Change Effects c) Renewable Energy: A Sustainable Future d) Solar Power Only

Section V: Logical Reasoning (1×15=15)

86. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the father of c b) a is the brother of c c) a is the son of c d) a is the uncle of c

87. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion I follows b) Both I and II follow c) Neither I nor II follows d) Only conclusion II follows

88. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 61 b) 67 c) 65 d) 63

89. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Aunt b) Daughter c) Mother d) Sister

90. Fill in the blank: MBN NBO OBP PBQ _____

a) RBQ b) QBR c) QBQ d) PBR

91. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Painting Found Near a Tree b) Painting Found Stolen by a Tree c) Tree Stole a Painting d) Tree Found Stolen Painting

92. Circle is to Sphere as Square is to:

a) Cylinder b) Cube c) Cone d) Rectangle

93. Find the next term: 1, 4, 9, 16, 25, ___

a) 36 b) 32 c) 30 d) 49

94. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Friday b) Saturday c) Sunday d) Monday

95. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EPH b) DPH c) EPG d) EOH

96. Which number should replace the question mark: 7, 14, 28, 56, ?

a) 84 b) 112 c) 120 d) 98

97. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) bowin b) ligowin c) bota d) winbo

98. Statement: Regular exercise improves cardiovascular health and mental well-being.

Conclusion I: People who exercise regularly tend to be healthier.

Conclusion II: People should exercise every day for one hour.

Which one is true?

a) Neither I nor II follows b) Only conclusion II follows c) Both I and II follow d) Only conclusion I follows

99. Statement: All students who study hard get good grades. Ram studies hard.

Conclusion: Ram gets good grades.

Does the conclusion follow?

a) Partially follows b) Follows c) Does not follow d) Cannot be determined

100. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) TBCMF b) UBCLF c) UACMF d) UBCMF

Answer Key — Set 10

1	2	3	4	5	6	7	8	9	10
b	c	a	a	a	c	b	d	b	b
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	b	d	b	a	a	d	c	b	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	d	d	b	a	c	c	b	c	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	b	d	b	b	c	d	a	a	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	a	c	d	d	a	b	b	c	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**

c	a	b	a	d	a	b	d	a	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	d	c	d	b	a	d	c	a	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
b	b	d	d	a	c	d	a	b	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	b	d	d	c	d	a	c	d	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	b	a	b	a	b	a	d	b	d

PRACTICE SET 11

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Invertible b) Symmetric c) Singular d) Orthogonal

2. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 0 b) 3 c) 1 d) 2

3. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 9 b) 3/4 c) 6 d) 4/3

4. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) e b) ∞ c) 1 d) 0

5. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Unity c) Zero d) Undefined

6. The sequence $b_n = \Sigma_{k=1}^{n}\, 1/(n+k)$ converges to:
a) ln 2 b) 1 c) It diverges d) e

7. Which of the following is an even function?
a) x^3 b) cos x c) x d) sin x

8. The general solution of dy/dx = y/x is:
a) $y = Cx^2$ b) y = C/x c) y = Cx d) $y = Ce^x$

9. The nullity of a 4×4 identity matrix is:
a) 4 b) 1 c) Undefined d) 0

10. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I and III only b) II only c) I only d) III only

11. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one and onto b) Neither one-one nor onto c) One-one but not onto d) Onto but not one-one

12. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = Ae^x + Be^{-x}$ b) $y = Ae^{ix}$ c) y = A cos x + B sin x d) y = A + Bx

13. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 0 b) e^(2x) c) 4e^(2x) d) −4e^(2x)

14. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 1 b) 9 c) 27 d) 3

15. Which of the following sets is countable?
a) Real numbers b) Rational numbers c) Irrational numbers d) The interval [0, 1]

16. A square matrix A is called orthogonal if:
a) $A^2 = I$ b) $A\, A^T = I$ c) det(A) = 0 d) $A = A^T$

17. The Laplace transform of sinh(3t) is:
a) $3/(s^2-9)$ b) $3/(s^2+9)$ c) $s/(s^2+9)$ d) $s/(s^2-9)$

18. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) ln x b) 1/x c) x d) x^2

19. $\int_0^1 1/(1+x^2)\, dx$ equals:

a) 1 b) π c) π/2 d) π/4

20. The determinant of a triangular matrix equals:
a) The sum of its diagonal elements b) The square of its trace c) Zero always d) The product of its diagonal elements

21. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 2 b) 0 c) 3 d) 1

22. The locus of the equation xz + yz = 0 is:
a) A pair of parallel planes b) A pair of perpendicular planes c) A straight line d) A single plane

23. The general solution of dy/dx = y/x is:
a) y = C/x b) y = Cx² c) y = Ce^x d) y = Cx

24. A square matrix A is called orthogonal if:
a) det(A) = 0 b) A = A^T c) A A^T = I d) A^2 = I

25. The value of ∫₀^π sin x dx is:
a) 1 b) π c) 2 d) 0

Section II: Statistics (1×25=25)

26. The standard deviation of a distribution is always:
a) Negative b) Undefined c) Zero d) Non-negative

27. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ² and λ b) λ and λ c) 1/λ and 1/λ² d) λ and λ²

28. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) The same width c) Cannot be determined d) Wider

29. Testing H_0: μ ≤ 50 vs H_1: μ > 50 leads to:
a) Two-tailed test b) None of the above c) One-sided upper-tailed test d) One-sided lower-tailed test

30. The sum of squares of deviations is minimum when measured from the:
a) Geometric mean b) Mean c) Median d) Mode

31. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$ b) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ d) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$

32. The binomial distribution tends to the normal distribution when:
a) np → λ (finite) b) n → 0 c) p → 0, n → ∞, np fixed d) n → ∞, p fixed

33. The variance of a constant c is:
a) 0 b) c² c) Undefined d) c

34. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) t-test c) Chi-square test d) Z-test

35. The geometric mean of 2, 4, and 8 is:
a) 8 b) 4.67 c) 5 d) 4

36. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) n²/2 b) (n−1)/2 c) n/2 d) (n+1)/2

37. In the hypergeometric distribution, the mean nK/N represents:
a) The population mean b) The mode c) The expected number of successes in the sample d) The variance

38. A Type I error is also known as:
a) Sampling error b) Standard error c) Alpha error (false positive) d) Beta error

39. Which measure of central tendency is most affected by extreme values (outliers)?
a) None of the above b) Mode c) Mean d) Median

40. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \le a)$ is computed using:
a) $Z = (a-\mu)/\sigma$ b) $Z = (a-\mu)\sigma$ c) $Z = (a-\mu)/\sqrt{n}$ d) $Z = (a-\mu)/\sigma^2$

41. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Zero c) Positive d) Negative

42. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 2 b) 13 c) 9 d) 4

43. If the two observations are 15 and −15, then their harmonic mean is:
a) ∞ (undefined) b) 0 c) −15 d) 15

44. The probability of an impossible event is:
a) 0.5 b) 0 c) 1 d) Undefined

45. The chi-square test statistic can never be:
a) Positive b) Negative c) Zero d) A decimal value

46. The sum of squares of deviations is minimum when measured from the:
a) Mode b) Mean c) Geometric mean d) Median

47. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Moving average method b) Free-hand curve method c) Least squares method d) Semi-average method

48. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ b) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ d) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$

49. The standard normal distribution has mean and variance:
a) 0 and 0 b) 0 and 1 c) 1 and 0 d) 1 and 1

50. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) (r−1)(c−1) b) r + c − 2 c) rc d) r + c

Section III: Computer Science and Information Technology (1×25=25)

51. HTTP stands for:
a) High Transfer Text Protocol b) HyperText Transmission Process c) Host Transfer Text Protocol d) HyperText Transfer Protocol

52. Which diagram is used to represent the flow of data in structured software analysis?
a) Use-case diagram b) Entity Relationship diagram c) Data Flow Diagram (DFD) d) Class diagram

53. Recursion in programming is best described as:
a) A function that never returns b) A function calling itself to solve smaller instances of a problem c) A data structure d) A loop with no exit condition

54. Which of the following is a NoSQL database?
a) Oracle b) MongoDB c) PostgreSQL d) MySQL

55. The OSI model has how many layers?
a) 8 b) 7 c) 6 d) 5

56. A primary key can contain:
a) Neither duplicate nor NULL values b) Only NULL values c) Duplicate values d) NULL values

57. Which of the following is used to uniquely identify a device on a network?
a) Domain name b) MAC address c) HTML tag d) URL

58. Which of the following is a valid IPv4 address?
a) 192.168.1 b) 192.168.1.1 c) 192.168.1.1.1 d) 192.168.1.256

59. Which of the following statements is executed by the preprocessor?
a) return 0; b) printf("Hello"); c) #define PI 3.14 d) void main()

60. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.224 b) 255.255.255.192 c) 255.255.255.128 d) 255.255.255.0

61. Which class of language is recognized by a pushdown automaton?
a) Regular language b) Recursively enumerable language c) Context-free language d) Context-sensitive language

62. The ability of objects to take on multiple forms is called:
a) Abstraction b) Inheritance c) Polymorphism d) Encapsulation

63. Which of the following is not a Database Management System?
a) MySQL b) Oracle c) PostgreSQL d) Windows

64. Which layer is responsible for routing data across different networks?
a) Application layer b) Data link layer c) Physical layer d) Network/Internet layer

65. Which data structure works on the LIFO (Last In First Out) principle?
a) Array b) Stack c) Linked list d) Queue

66. Which of the following information is required to normalize a relation into 3NF?
a) Functional dependency b) Join dependency c) None of the above d) Multivalued dependency

67. Which switching technique requires a dedicated path between sender and receiver?
a) None of the above b) Packet switching c) Message switching d) Circuit switching

68. Which sorting algorithm has the best average-case time complexity among the following?
a) Selection sort b) Insertion sort c) Quick sort d) Bubble sort

69. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Tree b) Queue c) Stack d) Graph

70. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 4NF b) 1NF c) 2NF d) BCNF

71. The OSI model has how many layers?
a) 8 b) 6 c) 7 d) 5

72. Which of the following best describes cloud computing?
a) A hardware component b) Storing data only on local computers c) A type of programming language d) Delivering computing services (storage, servers, software) over the internet

73. Which diagram is used to represent the flow of data in structured software analysis?
a) Class diagram b) Data Flow Diagram (DFD) c) Use-case diagram d) Entity Relationship diagram

74. Which of the following is the most common metric for measuring algorithm efficiency?
a) Time complexity (Big-O) b) Memory size c) Lines of code d) Programming language used

75. Which of the following statements is true regarding relational database keys?
a) A relation can have only one foreign key b) A relation can have only one candidate key c) A relation can have only one primary key d) A relation can have multiple candidate keys

Section IV: Technical English (1×10=10)

76. Choose the correct form: 'One of the students _____ absent today.'
a) is b) have been c) are d) were

77. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Adjective b) Adverb c) Noun d) Verb

78. Which of the following is a compound sentence?
a) Singing well is her passion. b) She sings well, and she dances gracefully. c) Because she practices, she sings well. d) She sings well.

79. Choose the correct comparative form: 'This problem is _____ than the previous one.'
a) more difficult b) most difficult c) difficultest d) difficult

80. 'By the time we arrived, the movie _____.'
a) had already started b) already starts c) already started d) has already started

81. Neither the teacher nor the students …… present.
a) has been b) were c) was d) is

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:
a) Job displacement and data privacy b) AI is only used in healthcare c) AI cannot analyze data d) AI is too expensive

83. According to the passage, what do experts recommend?
a) Ignoring privacy concerns b) A balanced approach combining innovation and ethical safeguards c) Using AI only in finance d) Banning AI completely

84. The tone of the passage is:
a) Sarcastic b) Purely promotional c) Purely critical d) Balanced and analytical

85. The most suitable title for the passage is:
a) Healthcare Systems Today b) The Dangers of Technology c) Artificial Intelligence: Opportunities and Challenges d) Finance in the Modern Age

Section V: Logical Reasoning (1×15=15)

86. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 20 b) 22 c) 18 d) 24

87. All cats are animals. No animal is a plant. Therefore:
a) No cat is a plant b) All plants are animals c) Some cats are plants d) No conclusion can be drawn

88. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 18 b) 24 c) 22 d) 20

89. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?
a) Tree Stole a Painting b) Painting Found Stolen by a Tree c) Tree Found Stolen Painting d) Painting Found Near a Tree

90. Which of the following is NOT a useful principle for making scientific progress?
a) Divide the problem into manageable components b) Compare similar cases to isolate the relevant difference c) Look only for confirming evidence and ignore disconfirming evidence d) Actively seek disconfirming evidence as well

91. If the day before yesterday was Wednesday, what day will it be tomorrow?
a) Saturday b) Sunday c) Monday d) Friday

92. Choose the word that does NOT belong with the others:
a) Circle b) Square c) Cube d) Triangle

93. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 84 b) 112 c) 98 d) 120

94. Circle is to Sphere as Square is to:
a) Rectangle b) Cube c) Cone d) Cylinder

95. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the brother of c b) a is the uncle of c c) a is the father of c d) a is the son of c

96. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 44 b) 42 c) 36 d) 40

97. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Only conclusion II follows b) Both I and II follow c) Only conclusion I follows d) Neither I nor II follows

98. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) Could you please close the door? b) He scored the highest marks in class c) The Earth revolves around the Sun d) Water boils at 100°C at sea level

99. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 64 b) 63 c) 62 d) 61

100. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Both I and II follow b) Only conclusion II follows c) Neither I nor II follows d) Only conclusion I follows

Answer Key — Set 11

1	2	3	4	5	6	7	8	9	10
c	b	b	b	c	a	b	c	d	a
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	c	a	d	b	b	a	c	d	d
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	b	d	c	c	d	b	d	c	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	d	a	a	d	d	c	c	c	a
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	a	b	b	b	c	a	b	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
d	c	b	b	b	a	b	b	c	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	c	d	d	b	a	d	c	b	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	d	b	a	d	a	b	b	a	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	a	b	d	c	a	a	d	d	c

91	92	93	94	95	96	97	98	99	100
a	c	b	b	b	b	c	a	b	d

PRACTICE SET 12

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 3 b) 0 c) 2 d) 1

2. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 120 b) 25 c) 3125 d) 5

3. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, −1 b) 1, 1 c) −1, −1 d) 0, 0

4. Which of the following sets is countable?
a) Irrational numbers b) Rational numbers c) Real numbers d) The interval [0, 1]

5. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) III only b) I and III only c) II only d) I only

6. Which of the following is an even function?
a) cos x b) sin x c) x d) x^3

7. The nullity of a 4×4 identity matrix is:
a) 0 b) 4 c) Undefined d) 1

8. A monotonic decreasing bounded sequence converges to its:
a) Infimum b) Maximum c) Upper bound d) Supremum

9. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 4/√34 b) 5/√34 c) 3/√34 d) 5/34

10. The Wronskian of two linearly dependent functions is:
a) 1 b) Undefined c) 0 d) −1

11. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Symmetric b) Singular c) Invertible d) Orthogonal

12. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) Onto but not one-one b) One-one and onto c) Neither one-one nor onto d) One-one but not onto

13. Which of the following statements is true?
a) Every convergent sequence is bounded b) Every sequence has a limit c) Every monotonic sequence converges d) Every bounded sequence is convergent

14. Let $f(x) = x^2$ for $x \leq 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Continuous but not differentiable at x = 0 b) An even function c) Discontinuous at x = 0 d) Differentiable at x = 0

15. The determinant of a triangular matrix equals:
a) The square of its trace b) Zero always c) The product of its diagonal elements d) The sum of its diagonal elements

16. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(2,1), v=(1,2) b) u=(1,−1), v=(1,1) c) u=(1,1), v=(3,−1) d) u=(1,1), v=(1,1)

17. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) ∞ b) e c) 1 d) 0

18. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:

a) Oscillatory b) Conditionally convergent c) Divergent d) Convergent

19. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) e b) ∞ c) 1 d) 0

20. The Laplace transform of sinh(3t) is:
a) $s/(s^2-9)$ b) $3/(s^2-9)$ c) $3/(s^2+9)$ d) $s/(s^2+9)$

21. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 0 b) 2 c) -1 d) 1

22. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) 0 b) 1 c) ∞ d) Undefined

23. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π/4 b) π c) 1 d) π/2

24. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x b) x^2 c) 1/x d) ln x

25. The sequence $b_n = \sum_{k=1}^{n} 1/(n+k)$ converges to:
a) ln 2 b) e c) 1 d) It diverges

Section II: Statistics (1×25=25)

26. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 2 b) 4 c) 9 d) 13

27. The chi-square test statistic can never be:
a) Positive b) Negative c) Zero d) A decimal value

28. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_x(0.5)^x$ b) ${}_nC_x(0.5)^{(n-x)}$ c) ${}_nC_n(0.5)^x$ d) ${}_nC_x(0.5)^n$

29. The best fitted trend line is the one for which the sum of squares of errors is:
a) Maximum b) Minimum c) Zero d) Negative

30. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Skewness of X b) Mean of X c) Variance of X d) Kurtosis of X

31. If the correlation coefficient r = 0 between X and Y, it implies:
a) A negative relationship between X and Y b) No linear relationship between X and Y c) A perfect relationship between X and Y d) No relationship at all between X and Y

32. A Type I error is also known as:
a) Sampling error b) Alpha error (false positive) c) Beta error d) Standard error

33. Which measure of central tendency is most affected by extreme values (outliers)?
a) None of the above b) Mode c) Mean d) Median

34. Testing H_0: $\mu \le 50$ vs H_1: $\mu > 50$ leads to:
a) None of the above b) Two-tailed test c) One-sided upper-tailed test d) One-sided lower-tailed test

35. In stratified sampling, the population is divided into:
a) Random clusters b) Systematic intervals c) Homogeneous subgroups (strata) d) Equal-sized random groups

36. The standard deviation of a distribution is always:
a) Negative b) Zero c) Undefined d) Non-negative

37. If two events A and B are independent, then $P(A \cap B)$ equals:
a) P(A) + P(B) b) P(A)/P(B) c) P(A) − P(B) d) P(A)·P(B)

38. The appropriate statistical test for comparing means across more than two independent groups is:

a) t-test b) Z-test c) Chi-square test d) F-test (ANOVA)

39. The statistical test generally used to test association between two independent categorical variables is:
a) F-test b) t-test c) Chi-square test d) Z-test

40. The probability of an impossible event is:
a) Undefined b) 1 c) 0 d) 0.5

41. In simple random sampling without replacement from a finite population, each unit has:
a) A probability depending on order drawn b) Zero probability of selection c) An unequal probability of selection d) An equal probability of selection

42. The variance of a constant c is:
a) c^2 b) 0 c) Undefined d) c

43. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) $(n-1)/2$ b) $(n+1)/2$ c) $n/2$ d) $n^2/2$

44. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Wider b) Cannot be determined c) Narrower d) The same width

45. If the two observations are 15 and −15, then their harmonic mean is:
a) ∞ (undefined) b) −15 c) 15 d) 0

46. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 5/8 b) 1/8 c) 3/8 d) 1/2

47. The p-value in hypothesis testing represents:
a) The probability that H_0 is true b) The probability that H_1 is true c) The probability of observing the data (or more extreme), given H_0 is true d) The significance level itself

48. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Positive b) Unity c) Zero d) Negative

49. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sigma$ b) $Z = (a-\mu)/\sigma^2$ c) $Z = (a-\mu)\sigma$ d) $Z = (a-\mu)/\sqrt{n}$

50. The coefficient of variation is computed using the formula:
a) 100/(mean × s.d.) b) (mean/s.d.) × 100 c) (mean × s.d.)/100 d) (s.d./mean) × 100

Section III: Computer Science and Information Technology (1×25=25)

51. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 4NF b) BCNF c) 2NF d) 1NF

52. Which class of language is recognized by a pushdown automaton?
a) Context-free language b) Recursively enumerable language c) Context-sensitive language d) Regular language

53. A deadlock in an operating system occurs when:
a) Two or more processes wait indefinitely for resources held by each other b) A process uses too much CPU c) A process completes execution d) None of the above

54. Which SDLC phase focuses on gathering and documenting user requirements?
a) Requirement Analysis b) Testing c) Design d) Maintenance

55. Which of the following is an example of secondary memory?
a) Cache b) RAM c) Hard disk d) Register

56. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Fluorescence b) Refresh rate c) Phosphorescence d) Persistence

57. Which of the following information is required to normalize a relation into 3NF?
a) Join dependency b) Functional dependency c) Multivalued dependency d) None of the above

58. The result of $(11010)_2 - (1011)_2$ is:
a) 11100 b) 01111 c) 01110 d) 10101

59. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) TRUNCATE c) REMOVE d) DELETE

60. Which sorting algorithm has the best average-case time complexity among the following?
a) Quick sort b) Bubble sort c) Selection sort d) Insertion sort

61. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Stack c) Queue d) Tree

62. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Polymorphism b) Inheritance c) Encapsulation d) Abstraction

63. HTTP stands for:
a) Host Transfer Text Protocol b) High Transfer Text Protocol c) HyperText Transmission Process d) HyperText Transfer Protocol

64. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) WHERE, SELECT, FROM d) SELECT, FROM, WHERE

65. Which of the following statements is executed by the preprocessor?
a) return 0; b) void main() c) #define PI 3.14 d) printf("Hello");

66. Recursion in programming is best described as:
a) A loop with no exit condition b) A function calling itself to solve smaller instances of a problem c) A data structure d) A function that never returns

67. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Excel b) Photoshop c) SPSS d) MS Paint

68. Which of the following is used to uniquely identify a device on a network?
a) MAC address b) URL c) Domain name d) HTML tag

69. Which normal form removes partial dependency on a composite primary key?
a) BCNF b) 2NF c) 1NF d) 3NF

70. The ability of objects to take on multiple forms is called:
a) Encapsulation b) Abstraction c) Polymorphism d) Inheritance

71. Which protocol is used to send email?
a) SNMP b) HTTP c) SMTP d) FTP

72. After a rollback, a transaction is in _____ state.
a) Partially committed b) Committed c) Aborted d) Active

73. The time complexity of binary search on a sorted array of n elements is:
a) O(n log n) b) O(n) c) O(log n) d) O(1)

74. Which switching technique requires a dedicated path between sender and receiver?
a) Circuit switching b) Packet switching c) None of the above d) Message switching

75. A primary key can contain:
a) Duplicate values b) Only NULL values c) NULL values d) Neither duplicate nor NULL values

Section IV: Technical English (1×10=10)

76. "The thief was caught red-handed by the police." This means:

a) The thief was caught while committing the crime b) The police painted the thief's hand c) The thief was injured d) The thief's hands were painted red

77. Choose the correctly punctuated sentence:

a) Its' a nice day b) Its a nice day c) It's a nice day d) It is'nt a nice day

78. 'He is used to _____ early.'

a) wake b) waken c) waking d) woke

79. He asked me ……

a) where I lived b) that where do I live c) that where I lived d) where I will live

80. Identify the correctly punctuated sentence:

a) Although it was, raining we went for a walk. b) Although it was raining, we went for a walk. c) Although, it was raining we went for a walk. d) Although it was raining we, went for a walk.

81. The antonym of 'diligent' is:

a) Careful b) Punctual c) Lazy d) Hardworking

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:

a) Agriculture b) None of the above c) Education, healthcare, and employment d) Only entertainment

83. Which of the following is mentioned as a challenge of urbanization?

a) Excess housing b) Traffic congestion c) Low population d) Abundant farmland

84. What does the passage suggest is essential for livable cities?

a) Reducing population to zero b) Sustainable urban planning c) Removing green spaces d) Banning public transport

85. The passage is primarily about:

a) The opportunities and challenges of urbanization b) Rural life c) The history of cities d) Global warming

Section V: Logical Reasoning (1×15=15)

86. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Sister b) Aunt c) Mother d) Daughter

87. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) so b) since c) Both a and b d) No conclusion

88. Find the missing number: 2, 5, 10, 17, 26, ___

a) 36 b) 35 c) 38 d) 37

89. Find the next term: 1, 4, 9, 16, 25, ___

a) 32 b) 30 c) 49 d) 36

90. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 63 b) 65 c) 67 d) 61

91. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) All Lazzies are Bloops b) All Bloops are Lazzies c) No Bloops are Lazzies d) Some Lazzies are not Razzies

92. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion II follows b) Only conclusion I follows c) Both I and II follow d) Neither I nor II follows

93. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Grandfather b) Uncle c) Brother d) Father

94. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) ligowin b) bota c) winbo d) bowin

95. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?
a) EPH b) EPG c) DPH d) EOH

96. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?
a) TBCMF b) UBCMF c) UACMF d) UBCLF

97. Fill in the blank: MBN NBO OBP PBQ _____
a) QBQ b) QBR c) RBQ d) PBR

98. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) None of the statements is true b) II only c) I, II, and III d) II and III only

99. Find the odd one out:
a) Apple b) Carrot c) Mango d) Banana

100. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Does not follow b) Follows c) Cannot be determined d) Partially follows

Answer Key — Set 12

1	2	3	4	5	6	7	8	9	10
c	a	a	b	b	a	a	a	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	d	a	a	c	c	a	c	a	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
d	b	a	a	a	a	b	d	b	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	b	c	c	c	d	d	d	c	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
d	b	b	a	a	c	c	a	a	d
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	a	a	a	c	a	b	b	a	a
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	b	d	a	c	b	a	a	b	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	c	c	a	d	a	c	c	a	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	c	b	b	a	a	a	d	d	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
b	b	d	d	a	b	b	d	b	b

PRACTICE SET 13

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 0 b) e^(2x) c) 4e^(2x) d) −4e^(2x)

2. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = Ae^{ix}$ b) $y = A\cos x + B\sin x$ c) $y = A + Bx$ d) $y = Ae^{x} + Be^{-x}$

3. Curl of the gradient of a scalar function is always:
a) Unity b) Zero c) Equal to its divergence d) Undefined

4. Complementary function of $(D^2 − 9)y = e^x$ is:
a) A cos3x + B sin3x b) $A e^{3x} + B e^{-3x}$ c) A cosh3x + B sinh3x d) $A e^{9x} + B e^{-9x}$

5. The derivative of ln(sin x) is:
a) sec x b) cot x c) tan x d) −cot x

6. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 6, 0 b) 4, 2 c) 2, −2 d) 3, 3

7. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 3 b) 27 c) 9 d) 1

8. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) An oblique tangent c) A horizontal tangent d) A vertical tangent

9. A continuous function on a closed and bounded interval [a, b] is always:
a) Differentiable on [a, b] b) Uniformly continuous on [a, b] c) Monotonic on [a, b] d) Unbounded on [a, b]

10. The particular integral of $(D^2 − 1)y = e^x$ is:
a) e^x b) $e^x/2$ c) $x\,e^x/2$ d) $x^2 e^x$

11. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 1 b) 3 c) 2 d) 0

12. The value of $\int e^x \cos x\,dx$ is:
a) $(e^x/2)(\sin x + \cos x) + C$ b) $(e^x/2)(\sin x − \cos x) + C$ c) $e^x \sin x + C$ d) $e^x \cos x + C$

13. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Infimum c) Minimum d) Supremum

14. The value of x from the equation $\log_3(x + 6) − \log_3 x = 2$ is:
a) 6 b) 4/3 c) 3/4 d) 9

15. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3^n is:
a) $6(2/3)^5$ b) $3(2/3)^5$ c) $6(2/3)^4$ d) $2(2/3)^5$

16. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 0 b) 1 c) 2 d) 3

17. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = Ae^{x} + Be^{-x}$ b) $y = A + Bx$ c) $y = Ae^{ix}$ d) $y = A\cos x + B\sin x$

18. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3^n is:
a) $2(2/3)^5$ b) $6(2/3)^4$ c) $3(2/3)^5$ d) $6(2/3)^5$

19. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 27 b) 1 c) 9 d) 3

20. The value of $\int_0^{\pi} \sin x \, dx$ is:
a) π b) 2 c) 0 d) 1

21. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A\cos 3x + B\sin 3x$ b) $A e^{3x} + B e^{-3x}$ c) $A e^{9x} + B e^{-9x}$ d) $A\cosh 3x + B\sinh 3x$

22. A continuous function on a closed and bounded interval [a, b] is always:
a) Differentiable on [a, b] b) Monotonic on [a, b] c) Unbounded on [a, b] d) Uniformly continuous on [a, b]

23. The Laplace transform of sinh(3t) is:
a) $3/(s^2-9)$ b) $3/(s^2+9)$ c) $s/(s^2-9)$ d) $s/(s^2+9)$

24. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Conditionally convergent b) Oscillatory c) Convergent d) Divergent

25. The Wronskian of two linearly dependent functions is:
a) 1 b) −1 c) 0 d) Undefined

Section II: Statistics (1×25=25)

26. Which distribution is used for testing the equality of two population variances?
a) Normal distribution b) F-distribution c) t-distribution d) Chi-square distribution

27. The correlation coefficient r always lies between:
a) 0 and ∞ b) −1 and 1 c) 0 and 1 d) −∞ and ∞

28. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.1 b) 0.3 c) −0.2 d) 0.2

29. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 23 b) 15.5 c) 16 d) 15

30. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 3 b) 5 c) 6 d) 4

31. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 60 b) 10 c) 15 d) 125

32. For a Poisson distribution, which of the following is true?
a) None of the above b) Mean = Variance c) Mean > Variance d) Mean < Variance

33. The coefficient of determination R^2 measures:
a) The proportion of variation in the dependent variable explained by the independent variable b) The proportion of variation in the independent variable explained by the dependent variable c) The total unexplained variation in the model d) None of the above

34. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Chebyshev's Inequality b) Bayes' Theorem c) Central Limit Theorem d) Law of Large Numbers

35. In hypothesis testing, a Type II error occurs when we:
a) None of the above b) Accept H_0 when H_0 is false c) Reject H_0 when H_0 is true d) Reject H_1 when H_1 is true

36. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Harmonic mean b) Geometric mean c) Median d) Arithmetic mean

37. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ and λ b) λ^2 and λ c) $1/\lambda$ and $1/\lambda^2$ d) λ and λ^2

38. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The variance c) The expected number of successes in the sample d) The population mean

39. The geometric mean of 2, 4, and 8 is:
a) 4.67 b) 4 c) 5 d) 8

40. The binomial distribution tends to the normal distribution when:
a) $p \to 0$, $n \to \infty$, np fixed b) $n \to 0$ c) $np \to \lambda$ (finite) d) $n \to \infty$, p fixed

41. The appropriate statistical test for comparing means across more than two independent groups is:
a) Z-test b) t-test c) Chi-square test d) F-test (ANOVA)

42. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Least squares method b) Free-hand curve method c) Moving average method d) Semi-average method

43. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) Two-tailed test b) None of the above c) One-sided upper-tailed test d) One-sided lower-tailed test

44. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) $(r-1)(c-1)$ b) $r + c - 2$ c) $r + c$ d) rc

45. If the correlation coefficient $r = 0$ between X and Y, it implies:
a) A negative relationship between X and Y b) No relationship at all between X and Y c) No linear relationship between X and Y d) A perfect relationship between X and Y

46. The coefficient of determination R^2 measures:
a) The total unexplained variation in the model b) The proportion of variation in the dependent variable explained by the independent variable c) The proportion of variation in the independent variable explained by the dependent variable d) None of the above

47. If the two observations are 15 and −15, then their harmonic mean is:
a) 15 b) −15 c) ∞ (undefined) d) 0

48. The probability of an impossible event is:
a) 0.5 b) 1 c) Undefined d) 0

49. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The variance c) The expected number of successes in the sample d) The population mean

50. The coefficient of variation is computed using the formula:
a) (mean × s.d.)/100 b) (mean/s.d.) × 100 c) (s.d./mean) × 100 d) 100/(mean × s.d.)

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following is a valid IPv4 address?
a) 192.168.1.1 b) 192.168.1.256 c) 192.168.1.1.1 d) 192.168.1

52. A firewall is primarily used to:
a) Store data backups b) Compress files c) Control and filter network traffic for security d) Speed up an internet connection

53. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.224 b) 255.255.255.192 c) 255.255.255.128 d) 255.255.255.0

54. IP in the context of networking stands for:
a) Internal Process b) Information Packet c) Internet Protocol d) Interface Path

55. Which of the following is a compiled language?
a) C b) PHP c) JavaScript d) Python

56. Which of the following is an entry-controlled loop?
a) Both while and do-while b) while c) do-while d) None of the above

57. Which of the following is an example of supervised learning?
a) Association rule mining b) K-means clustering c) Principal Component Analysis d) Linear regression

58. Which layer is responsible for routing data across different networks?
a) Network/Internet layer b) Physical layer c) Application layer d) Data link layer

59. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 4 b) 5 c) 6 d) 10

60. Which of the following is not a Database Management System?
a) Oracle b) MySQL c) Windows d) PostgreSQL

61. Round-robin scheduling is the preemptive version of:
a) Shortest Job First b) First Come First Serve (FCFS) c) None of the above d) Priority Scheduling

62. Which system development approach is best suited when requirements evolve continuously?
a) None of the above b) Waterfall c) V-model d) Agile

63. In machine learning, overfitting refers to a model that:
a) Performs well on training data but poorly on new/unseen data b) Performs poorly on training data c) Cannot be trained at all d) Performs equally well on all datasets

64. Which of the following is a NoSQL database?
a) MySQL b) PostgreSQL c) Oracle d) MongoDB

65. Which data structure works on the LIFO (Last In First Out) principle?
a) Linked list b) Queue c) Stack d) Array

66. Which software is most commonly used for spreadsheet-based data analysis?
a) SPSS b) MS Paint c) Photoshop d) MS Excel

67. Which switching technique requires a dedicated path between sender and receiver?
a) Message switching b) Packet switching c) Circuit switching d) None of the above

68. Which class of language is recognized by a pushdown automaton?
a) Recursively enumerable language b) Context-sensitive language c) Context-free language d) Regular language

69. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Stack c) Queue d) Tree

70. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) WHERE, SELECT, FROM b) FROM, SELECT, WHERE c) FROM, WHERE, SELECT d) SELECT, FROM, WHERE

71. Which of the following is used to uniquely identify a device on a network?
a) HTML tag b) Domain name c) MAC address d) URL

72. HTTP stands for:
a) High Transfer Text Protocol b) HyperText Transmission Process c) Host Transfer Text Protocol d) HyperText Transfer Protocol

73. Which of the following is the most common metric for measuring algorithm efficiency?
a) Time complexity (Big-O) b) Programming language used c) Memory size d) Lines of code

74. Which system development approach is best suited when requirements evolve continuously?
a) Waterfall b) V-model c) Agile d) None of the above

75. Which of the following is an example of secondary memory?
a) Hard disk b) Cache c) Register d) RAM

Section IV: Technical English (1×10=10)

76. The synonym of 'abundant' is:
a) Rare b) Plentiful c) Scarce d) Limited

77. The idiom 'to hit the nail on the head' means:

a) To hurt someone b) To say or do something exactly right c) To work with tools d) To make a mistake

78. Choose the correctly spelled word:

a) Recieve b) Receive c) Receve d) Receiv

79. The phrase 'in the nick of time' means:

a) At the very last possible moment b) In the near future c) At the beginning d) Too late

80. "He is the black sheep of the family." The underlined expression has …… meaning.

a) Figurative b) Contextual c) Poetic d) Literal

81. 'Actions speak louder than words' means:

a) Words are more powerful than actions b) Actions are always loud c) Silence is golden d) What people do matters more than what they say

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:

a) Governments dislike renewable energy b) Renewable energy is gaining importance due to environmental benefits
c) Wind energy is the only alternative d) Fossil fuels are better than renewables

83. The mode of approach in the passage is:

a) Descriptive b) Narrative c) Poetic d) Argumentative

84. According to the passage, one benefit of renewable energy is:

a) Requiring fossil fuel input b) Low greenhouse gas emissions c) High cost d) Limited availability

85. The most appropriate title for the passage is:

a) The Decline of Fossil Fuels b) Climate Change Effects c) Renewable Energy: A Sustainable Future d) Solar Power Only

Section V: Logical Reasoning (1×15=15)

86. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.

If the above are true, which must also be true?

I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly

a) None of the statements is true b) II and III only c) II only d) I, II, and III

87. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.

Conclusion II: The economic slowdown affected the company.

Which one is true?

a) Neither I nor II follows b) Only conclusion I follows c) Both I and II follow d) Only conclusion II follows

88. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Sunday b) Monday c) Saturday d) Friday

89. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) since b) so c) Both a and b d) No conclusion

90. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Tree Stole a Painting b) Painting Found Stolen by a Tree c) Painting Found Near a Tree d) Tree Found Stolen Painting

91. Which of the following is NOT a useful principle for making scientific progress?

a) Look only for confirming evidence and ignore disconfirming evidence b) Compare similar cases to isolate the relevant difference c) Actively seek disconfirming evidence as well d) Divide the problem into manageable components

92. Read the following carefully:

I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?

a) a is the uncle of c b) a is the son of c c) a is the brother of c d) a is the father of c

93. Find the next term: 1, 4, 9, 16, 25, ___

a) 30 b) 32 c) 36 d) 49

94. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?

a) Cannot be determined b) Does not follow c) Follows d) Partially follows

95. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) All Lazzies are Bloops b) No Bloops are Lazzies c) Some Lazzies are not Razzies d) All Bloops are Lazzies

96. All cats are animals. No animal is a plant. Therefore:

a) No cat is a plant b) Some cats are plants c) All plants are animals d) No conclusion can be drawn

97. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 61 b) 64 c) 62 d) 63

98. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 65 b) 67 c) 63 d) 61

99. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?

a) 20 b) 22 c) 24 d) 18

100. Circle is to Sphere as Square is to:

a) Rectangle b) Cone c) Cube d) Cylinder

Answer Key — Set 13

1	2	3	4	5	6	7	8	9	10
a	b	b	b	b	b	a	d	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	a	b	c	a	c	d	d	d	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	d	a	d	c	b	b	d	b	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	b	a	c	b	b	a	c	b	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
d	a	c	a	c	b	c	d	c	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	c	b	c	a	b	d	a	b	c
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b	d	a	d	c	d	c	c	c	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	d	a	c	a	b	b	b	a	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
d	b	a	b	c	b	b	c	b	c

91	92	93	94	95	96	97	98	99	100
a	a	c	c	d	a	d	a	a	c

PRACTICE SET 14

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The value of $\int e^x \cos x \, dx$ is:
a) $(e^x/2)(\sin x + \cos x) + C$ b) $e^x \sin x + C$ c) $(e^x/2)(\sin x - \cos x) + C$ d) $e^x \cos x + C$

2. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $x^2 e^x$ b) $x e^x/2$ c) $e^x/2$ d) e^x

3. The general solution of $dy/dx = y/x$ is:
a) $y = C/x$ b) $y = Cx^2$ c) $y = Ce^x$ d) $y = Cx$

4. The curve y = x^(1/3) at (0, 0) has:
a) A vertical tangent b) No tangent c) An oblique tangent d) A horizontal tangent

5. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 0, 0 b) 1, −1 c) −1, −1 d) 1, 1

6. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 2 b) 3 c) 1 d) 0

7. Let $f(x) = x^2$ for $x \leq 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Differentiable at x = 0 b) An even function c) Discontinuous at x = 0 d) Continuous but not differentiable at x = 0

8. Which of the following is an even function?
a) sin x b) x^3 c) x d) cos x

9. Let $f: (0,1) \to (0,1)$ be defined by $f(x) = x^2$. Then f is:
a) Onto but not one-one b) One-one and onto c) One-one but not onto d) Neither one-one nor onto

10. The radius of convergence of the series $\Sigma x^n/n!$ is:
a) 0 b) e c) ∞ d) 1

11. The locus of the equation xz + yz = 0 is:
a) A pair of parallel planes b) A pair of perpendicular planes c) A single plane d) A straight line

12. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) 1/x b) x^2 c) x d) ln x

13. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 4e^(2x) b) e^(2x) c) 0 d) −4e^(2x)

14. Curl of the gradient of a scalar function is always:
a) Unity b) Zero c) Equal to its divergence d) Undefined

15. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 3 b) 0 c) 2 d) 1

16. With inner product $\langle u,v \rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(1,1) b) u=(2,1), v=(1,2) c) u=(1,1), v=(3,−1) d) u=(1,−1), v=(1,1)

17. A square matrix A is called orthogonal if:
a) $A A^T = I$ b) $A = A^T$ c) det(A) = 0 d) $A^2 = I$

18. The sequence $b_n = \Sigma_{k=1}^{n} 1/(n+k)$ converges to:
a) ln 2 b) 1 c) e d) It diverges

19. Which of the following statements is true?

a) Every bounded sequence is convergent b) Every sequence has a limit c) Every convergent sequence is bounded d) Every monotonic sequence converges

20. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 4/3 b) 3/4 c) 9 d) 6

21. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 25 b) 120 c) 3125 d) 5

22. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I and III only b) III only c) I only d) II only

23. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) ∞ b) Undefined c) 1 d) 0

24. A monotonic decreasing bounded sequence converges to its:
a) Supremum b) Maximum c) Infimum d) Upper bound

25. The derivative of ln(sin x) is:
a) tan x b) sec x c) −cot x d) cot x

Section II: Statistics (1×25=25)

26. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Arithmetic mean b) Harmonic mean c) Geometric mean d) Median

27. In hypothesis testing, a Type II error occurs when we:
a) Reject H_0 when H_0 is true b) Reject H_1 when H_1 is true c) Accept H_0 when H_0 is false d) None of the above

28. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.3 b) 0.1 c) 0.2 d) −0.2

29. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Variance of X b) Skewness of X c) Kurtosis of X d) Mean of X

30. The standard deviation of a distribution is always:
a) Undefined b) Negative c) Zero d) Non-negative

31. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Law of Large Numbers b) Central Limit Theorem c) Chebyshev's Inequality d) Bayes' Theorem

32. For a Poisson distribution, which of the following is true?
a) Mean < Variance b) None of the above c) Mean = Variance d) Mean > Variance

33. The sum of squares of deviations is minimum when measured from the:
a) Mean b) Mode c) Geometric mean d) Median

34. In stratified sampling, the population is divided into:
a) Random clusters b) Equal-sized random groups c) Homogeneous subgroups (strata) d) Systematic intervals

35. The p-value in hypothesis testing represents:
a) The probability of observing the data (or more extreme), given H_0 is true b) The significance level itself c) The probability that H_1 is true d) The probability that H_0 is true

36. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mean b) None of the above c) Mode d) Median

37. The standard normal distribution has mean and variance:
a) 1 and 1 b) 1 and 0 c) 0 and 0 d) 0 and 1

38. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) $1/\lambda$ and $1/\lambda^2$ b) λ and λ c) λ^2 and λ d) λ and λ^2

39. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 5/8 c) 1/8 d) 1/2

40. The best fitted trend line is the one for which the sum of squares of errors is:
a) Minimum b) Zero c) Maximum d) Negative

41. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15 b) 16 c) 15.5 d) 23

42. The geometric mean of 2, 4, and 8 is:
a) 8 b) 4 c) 5 d) 4.67

43. The variance of a constant c is:
a) c b) Undefined c) 0 d) c^2

44. In simple random sampling without replacement from a finite population, each unit has:
a) An unequal probability of selection b) A probability depending on order drawn c) An equal probability of selection d) Zero probability of selection

45. Which distribution is used for testing the equality of two population variances?
a) Chi-square distribution b) F-distribution c) Normal distribution d) t-distribution

46. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) + P(B)$ b) $P(A) - P(B)$ c) $P(A)/P(B)$ d) $P(A) \cdot P(B)$

47. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 5 b) 6 c) 3 d) 4

48. The chi-square test statistic can never be:
a) Zero b) A decimal value c) Negative d) Positive

49. The correlation coefficient r always lies between:
a) $-\infty$ and ∞ b) 0 and ∞ c) 0 and 1 d) −1 and 1

50. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 9 c) 4 d) 2

Section III: Computer Science and Information Technology (1×25=25)

51. Which layer is responsible for routing data across different networks?
a) Physical layer b) Data link layer c) Network/Internet layer d) Application layer

52. Which of the following information is required to normalize a relation into 3NF?
a) Join dependency b) Functional dependency c) Multivalued dependency d) None of the above

53. A deadlock in an operating system occurs when:
a) None of the above b) A process uses too much CPU c) Two or more processes wait indefinitely for resources held by each other d) A process completes execution

54. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.224 b) 255.255.255.0 c) 255.255.255.192 d) 255.255.255.128

55. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 2NF b) 4NF c) BCNF d) 1NF

56. Which SQL command removes a table completely from a database, including its structure?
a) TRUNCATE b) REMOVE c) DELETE d) DROP

57. After a rollback, a transaction is in _____ state.

a) Active b) Partially committed c) Aborted d) Committed

58. The result of $(11010)_2 - (1011)_2$ is:
a) 01111 b) 01110 c) 11100 d) 10101

59. A firewall is primarily used to:
a) Store data backups b) Compress files c) Speed up an internet connection d) Control and filter network traffic for security

60. The OSI model has how many layers?
a) 6 b) 8 c) 5 d) 7

61. Which of the following statements is executed by the preprocessor?
a) return 0; b) void main() c) printf("Hello"); d) #define PI 3.14

62. The ability of objects to take on multiple forms is called:
a) Polymorphism b) Inheritance c) Abstraction d) Encapsulation

63. Which SDLC phase focuses on gathering and documenting user requirements?
a) Maintenance b) Requirement Analysis c) Design d) Testing

64. Which of the following best describes cloud computing?
a) A hardware component b) A type of programming language c) Storing data only on local computers d) Delivering computing services (storage, servers, software) over the internet

65. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Inheritance b) Abstraction c) Encapsulation d) Polymorphism

66. Which diagram is used to represent the flow of data in structured software analysis?
a) Use-case diagram b) Entity Relationship diagram c) Data Flow Diagram (DFD) d) Class diagram

67. Which normal form removes partial dependency on a composite primary key?
a) 2NF b) 1NF c) 3NF d) BCNF

68. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1 c) 192.168.1.1 d) 192.168.1.1.1

69. Which of the following statements is true regarding relational database keys?
a) A relation can have only one primary key b) A relation can have only one foreign key c) A relation can have multiple candidate keys d) A relation can have only one candidate key

70. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Fluorescence b) Refresh rate c) Persistence d) Phosphorescence

71. Recursion in programming is best described as:
a) A function calling itself to solve smaller instances of a problem b) A data structure c) A function that never returns d) A loop with no exit condition

72. Which of the following is not a Database Management System?
a) Oracle b) Windows c) MySQL d) PostgreSQL

73. Round-robin scheduling is the preemptive version of:
a) Priority Scheduling b) None of the above c) Shortest Job First d) First Come First Serve (FCFS)

74. IP in the context of networking stands for:
a) Internal Process b) Interface Path c) Information Packet d) Internet Protocol

75. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 4 b) 5 c) 6 d) 10

Section IV: Technical English (1×10=10)

76. Choose the correct passive voice of 'She is writing a letter.'

a) A letter has been written by her b) A letter is written by her c) A letter is being written by her d) A letter was being written by her

77. Choose the word closest in meaning to 'meticulous':

a) Careful and precise b) Careless c) Confused d) Quick

78. Choose the correct form: 'One of the students _____ absent today.'

a) are b) is c) have been d) were

79. Identify the correctly punctuated sentence:

a) Although it was raining, we went for a walk. b) Although it was raining we, went for a walk. c) Although it was, raining we went for a walk. d) Although, it was raining we went for a walk.

80. The phrase 'in the nick of time' means:

a) In the near future b) Too late c) At the beginning d) At the very last possible moment

81. "She always works diligently." The part of speech of the underlined word 'diligently' is:

a) Adjective b) Adverb c) Noun d) Verb

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:

a) AI is too expensive b) AI cannot analyze data c) AI is only used in healthcare d) Job displacement and data privacy

83. According to the passage, what do experts recommend?

a) Banning AI completely b) Using AI only in finance c) Ignoring privacy concerns d) A balanced approach combining innovation and ethical safeguards

84. The tone of the passage is:

a) Purely critical b) Purely promotional c) Balanced and analytical d) Sarcastic

85. The most suitable title for the passage is:

a) Finance in the Modern Age b) The Dangers of Technology c) Healthcare Systems Today d) Artificial Intelligence: Opportunities and Challenges

Section V: Logical Reasoning (1×15=15)

86. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) Water boils at 100°C at sea level b) Could you please close the door? c) The Earth revolves around the Sun d) He scored the highest marks in class

87. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 44 b) 36 c) 42 d) 40

88. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) bota b) bowin c) winbo d) ligowin

89. Statement: Regular exercise improves cardiovascular health and mental well-being.

Conclusion I: People who exercise regularly tend to be healthier.

Conclusion II: People should exercise every day for one hour.

Which one is true?

a) Neither I nor II follows b) Only conclusion II follows c) Only conclusion I follows d) Both I and II follow

90. Find the missing number: 2, 5, 10, 17, 26, ___

a) 38 b) 36 c) 37 d) 35

91. Fill in the blank: MBN NBO OBP PBQ _____

a) RBQ b) QBQ c) PBR d) QBR

92. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Daughter b) Mother c) Sister d) Aunt

93. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UACMF b) TBCMF c) UBCMF d) UBCLF

94. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EPH b) DPH c) EPG d) EOH

95. Choose the word that does NOT belong with the others:

a) Triangle b) Square c) Cube d) Circle

96. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.

Conclusion II: All erasers are pencils.

Which one is true?

a) Only conclusion I follows b) Both I and II follow c) Only conclusion II follows d) Neither I nor II follows

97. Which number should replace the question mark: 7, 14, 28, 56, ?

a) 84 b) 98 c) 112 d) 120

98. Find the odd one out:

a) Mango b) Apple c) Banana d) Carrot

99. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 24 b) 22 c) 20 d) 18

100. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Father b) Brother c) Uncle d) Grandfather

Answer Key — Set 14

1	2	3	4	5	6	7	8	9	10
a	b	d	a	b	a	d	d	c	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	c	c	b	a	c	a	a	c	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	a	c	c	d	c	c	c	a	d
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	c	a	c	a	a	d	b	a	a
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	b	c	c	b	d	a	c	d	d
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	b	c	c	c	d	c	a	d	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	a	b	d	a	c	a	c	c	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	b	d	d	b	c	a	b	a	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	d	d	c	d	b	c	b	c	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	c	c	a	c	a	c	d	c	a

PRACTICE SET 15

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Which of the following sets is countable?
a) The interval [0, 1] b) Real numbers c) Rational numbers d) Irrational numbers

2. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 4, 2 c) 3, 3 d) 6, 0

3. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Singular b) Orthogonal c) Symmetric d) Invertible

4. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 2 b) -1 c) 1 d) 0

5. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π b) 1 c) π/4 d) π/2

6. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Supremum c) Infimum d) Minimum

7. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/√34 b) 5/34 c) 4/√34 d) 3/√34

8. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) 1 b) e c) ∞ d) 0

9. The nullity of a 4×4 identity matrix is:
a) 1 b) 0 c) Undefined d) 4

10. The determinant of a triangular matrix equals:
a) The square of its trace b) Zero always c) The sum of its diagonal elements d) The product of its diagonal elements

11. The general solution of dy/dx = y/x is:
a) $y = Cx$ b) $y = C/x$ c) $y = Cx^2$ d) $y = Ce^x$

12. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 3, 3 c) 4, 2 d) 6, 0

13. The value of $\int e^x \cos x\,dx$ is:
a) $(e^x/2)(\sin x + \cos x) + C$ b) $e^x \cos x + C$ c) $(e^x/2)(\sin x - \cos x) + C$ d) $e^x \sin x + C$

14. The Wronskian of two linearly dependent functions is:
a) 0 b) Undefined c) 1 d) −1

15. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 4e^(2x) b) 0 c) e^(2x) d) −4e^(2x)

16. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 120 b) 5 c) 25 d) 3125

17. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) e b) 1 c) 0 d) ∞

18. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Supremum c) Minimum d) Infimum

19. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3^n is:

a) $6(2/3)^4$ b) $6(2/3)^5$ c) $3(2/3)^5$ d) $2(2/3)^5$

20. The determinant of a triangular matrix equals:
a) The square of its trace b) The sum of its diagonal elements c) The product of its diagonal elements d) Zero always

21. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 0 b) 1 c) -1 d) 2

22. Let $f(x) = |x - 1|$. Which of the following about f at $x = 1$ is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) II only c) III only d) I and III only

23. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 2 b) 0 c) 1 d) 3

24. A square matrix A is called orthogonal if:
a) $A^2 = I$ b) $A = A^T$ c) $\det(A) = 0$ d) $A\,A^T = I$

25. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x^2 b) $\ln x$ c) x d) $1/x$

Section II: Statistics (1×25=25)

26. The binomial distribution tends to the normal distribution when:
a) $p \to 0, n \to \infty$, np fixed b) $n \to \infty$, p fixed c) $n \to 0$ d) $np \to \lambda$ (finite)

27. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$ b) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$

28. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \le a)$ is computed using:
a) $Z = (a-\mu)\sigma$ b) $Z = (a-\mu)/\sigma$ c) $Z = (a-\mu)/\sqrt{n}$ d) $Z = (a-\mu)/\sigma^2$

29. The statistical test generally used to test association between two independent categorical variables is:
a) t-test b) Chi-square test c) F-test d) Z-test

30. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 125 b) 15 c) 10 d) 60

31. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Positive b) Negative c) Zero d) Unity

32. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) $(n+1)/2$ b) $n/2$ c) $(n-1)/2$ d) $n^2/2$

33. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Cannot be determined b) Narrower c) The same width d) Wider

34. In a binomial distribution, if the probability of success $\pi = 0.5$, then $Pr(X=x)$ is given by:
a) ${}_nC_x(0.5)^n$ b) ${}_nC_x(0.5)^x$ c) ${}_nC_x(0.5)^{(n-x)}$ d) ${}_nC_n(0.5)^x$

35. A Type I error is also known as:
a) Alpha error (false positive) b) Sampling error c) Beta error d) Standard error

36. The chi-square test statistic can never be:
a) A decimal value b) Positive c) Zero d) Negative

37. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.1 b) 0.3 c) −0.2 d) 0.2

38. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 1/8 b) 1/2 c) 3/8 d) 5/8

39. The coefficient of variation is computed using the formula:
a) (mean/s.d.) × 100 b) 100/(mean × s.d.) c) (mean × s.d.)/100 d) (s.d./mean) × 100

40. If the two observations are 15 and −15, then their harmonic mean is:
a) −15 b) 0 c) 15 d) ∞ (undefined)

41. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/8\}$ b) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/2\}$ c) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/2\}$

42. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) (r−1)(c−1) b) r + c c) rc d) r + c − 2

43. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \le a)$ is computed using:
a) $Z = (a-\mu)/\sigma^2$ b) $Z = (a-\mu)\sigma$ c) $Z = (a-\mu)/\sigma$ d) $Z = (a-\mu)/\sqrt{n}$

44. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Law of Large Numbers b) Central Limit Theorem c) Chebyshev's Inequality d) Bayes' Theorem

45. In stratified sampling, the population is divided into:
a) Random clusters b) Equal-sized random groups c) Systematic intervals d) Homogeneous subgroups (strata)

46. The p-value in hypothesis testing represents:
a) The significance level itself b) The probability that H_0 is true c) The probability that H_1 is true d) The probability of observing the data (or more extreme), given H_0 is true

47. In a binomial distribution, if the probability of success π = 0.5, then Pr(X=x) is given by:
a) ${}_nC_n(0.5)^x$ b) ${}_nC_x(0.5)^{(n-x)}$ c) ${}_nC_x(0.5)^x$ d) ${}_nC_x(0.5)^n$

48. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) The same width b) Cannot be determined c) Narrower d) Wider

49. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ^2 and λ b) λ and λ^2 c) λ and λ d) 1/λ and $1/\lambda^2$

50. The correlation coefficient r always lies between:
a) 0 and ∞ b) −∞ and ∞ c) −1 and 1 d) 0 and 1

Section III: Computer Science and Information Technology (1×25=25)

51. Which protocol is used to send email?
a) SMTP b) FTP c) SNMP d) HTTP

52. A primary key can contain:
a) Neither duplicate nor NULL values b) Only NULL values c) Duplicate values d) NULL values

53. Which of the following is a NoSQL database?
a) MySQL b) PostgreSQL c) Oracle d) MongoDB

54. Which data structure works on the LIFO (Last In First Out) principle?
a) Stack b) Queue c) Array d) Linked list

55. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Selection sort c) Bubble sort d) Quick sort

56. Which of the following is a compiled language?
a) Python b) C c) PHP d) JavaScript

57. In machine learning, overfitting refers to a model that:

a) Performs poorly on training data b) Cannot be trained at all c) Performs well on training data but poorly on new/unseen data d) Performs equally well on all datasets

58. The time complexity of binary search on a sorted array of n elements is:

a) O(log n) b) O(n) c) O(n log n) d) O(1)

59. Which of the following is an entry-controlled loop?

a) do-while b) Both while and do-while c) while d) None of the above

60. Which of the following is an example of supervised learning?

a) K-means clustering b) Linear regression c) Association rule mining d) Principal Component Analysis

61. IP in the context of networking stands for:

a) Internet Protocol b) Internal Process c) Information Packet d) Interface Path

62. Which subnet mask should be used to divide a Class C address into 4 subnets?

a) 255.255.255.128 b) 255.255.255.0 c) 255.255.255.192 d) 255.255.255.224

63. A primary key can contain:

a) Neither duplicate nor NULL values b) Duplicate values c) Only NULL values d) NULL values

64. Which protocol is used to send email?

a) HTTP b) FTP c) SNMP d) SMTP

65. Which data structure is typically used for Breadth-First Search (BFS) traversal?

a) Tree b) Queue c) Stack d) Graph

66. Which normal form removes partial dependency on a composite primary key?

a) 1NF b) BCNF c) 3NF d) 2NF

67. Which system development approach is best suited when requirements evolve continuously?

a) Agile b) None of the above c) Waterfall d) V-model

68. Which of the following statements is executed by the preprocessor?

a) #define PI 3.14 b) printf("Hello"); c) return 0; d) void main()

69. Which of the following information is required to normalize a relation into 3NF?

a) Multivalued dependency b) Functional dependency c) None of the above d) Join dependency

70. Which of the following is an example of secondary memory?

a) Hard disk b) Register c) Cache d) RAM

71. How many times will the loop for(i=10; i>0; i-=2) execute?

a) 10 b) 5 c) 4 d) 6

72. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:

a) Persistence b) Refresh rate c) Phosphorescence d) Fluorescence

73. Which SQL command removes a table completely from a database, including its structure?

a) DROP b) REMOVE c) DELETE d) TRUNCATE

74. HTTP stands for:

a) HyperText Transmission Process b) Host Transfer Text Protocol c) High Transfer Text Protocol d) HyperText Transfer Protocol

75. Round-robin scheduling is the preemptive version of:

a) None of the above b) Shortest Job First c) First Come First Serve (FCFS) d) Priority Scheduling

Section IV: Technical English (1×10=10)

76. Choose the correct comparative form: 'This problem is _____ than the previous one.'

a) most difficult b) more difficult c) difficultest d) difficult

77. The synonym of 'abundant' is:
a) Rare b) Limited c) Scarce d) Plentiful

78. 'By the time we arrived, the movie _____.'
a) already starts b) had already started c) already started d) has already started

79. 'He is used to _____ early.'
a) waking b) wake c) waken d) woke

80. Neither the teacher nor the students …… present.
a) is b) was c) were d) has been

81. The idiom 'to hit the nail on the head' means:
a) To hurt someone b) To make a mistake c) To say or do something exactly right d) To work with tools

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:
a) Agriculture b) None of the above c) Only entertainment d) Education, healthcare, and employment

83. Which of the following is mentioned as a challenge of urbanization?
a) Excess housing b) Traffic congestion c) Low population d) Abundant farmland

84. What does the passage suggest is essential for livable cities?
a) Sustainable urban planning b) Removing green spaces c) Banning public transport d) Reducing population to zero

85. The passage is primarily about:
a) Global warming b) The history of cities c) Rural life d) The opportunities and challenges of urbanization

Section V: Logical Reasoning (1×15=15)

86. All cats are animals. No animal is a plant. Therefore:
a) All plants are animals b) No cat is a plant c) No conclusion can be drawn d) Some cats are plants

87. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 24 b) 18 c) 20 d) 22

88. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Neither I nor II follows b) Only conclusion II follows c) Both I and II follow d) Only conclusion I follows

89. Fill in the blank: MBN NBO OBP PBQ _____
a) PBR b) QBR c) RBQ d) QBQ

90. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 44 b) 36 c) 40 d) 42

91. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?
a) Daughter b) Mother c) Aunt d) Sister

92. Which number should replace the question mark: 7, 14, 28, 56, ?

a) 98 b) 112 c) 120 d) 84

93. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) All Bloops are Lazzies b) No Bloops are Lazzies c) All Lazzies are Bloops d) Some Lazzies are not Razzies

94. Choose the word that does NOT belong with the others:

a) Triangle b) Cube c) Square d) Circle

95. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Monday b) Sunday c) Friday d) Saturday

96. Circle is to Sphere as Square is to:

a) Rectangle b) Cube c) Cylinder d) Cone

97. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 20 b) 18 c) 22 d) 24

98. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 63 b) 64 c) 61 d) 62

99. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 67 b) 61 c) 63 d) 65

100. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) ligowin b) bowin c) bota d) winbo

Answer Key — Set 15

1	2	3	4	5	6	7	8	9	10
c	b	a	c	c	c	a	b	b	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	c	a	a	b	a	a	d	b	c
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	d	a	d	c	b	b	b	b	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	a	d	a	a	d	d	c	d	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	c	b	d	d	d	d	c	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	a	d	a	d	b	c	a	c	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
a	c	a	d	b	d	a	a	b	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
b	d	a	d	c	b	d	b	a	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	d	b	a	d	b	c	d	b	d
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	b	a	b	d	b	a	a	d	b

PRACTICE SET 16

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) ∞ b) 0 c) 1 d) e

2. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A + Bx$ b) $y = Ae^{ix}$ c) $y = A\cos x + B\sin x$ d) $y = Ae^{x} + Be^{-x}$

3. Which of the following sets is countable?
a) The interval [0, 1] b) Rational numbers c) Real numbers d) Irrational numbers

4. The nullity of a 4×4 identity matrix is:
a) Undefined b) 1 c) 0 d) 4

5. A monotonic decreasing bounded sequence converges to its:
a) Supremum b) Upper bound c) Maximum d) Infimum

6. The Laplace transform of sinh(3t) is:
a) $3/(s^2-9)$ b) $s/(s^2-9)$ c) $s/(s^2+9)$ d) $3/(s^2+9)$

7. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Invertible b) Orthogonal c) Singular d) Symmetric

8. The curve y = x^(1/3) at (0, 0) has:
a) A vertical tangent b) No tangent c) An oblique tangent d) A horizontal tangent

9. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) 0 b) ∞ c) Undefined d) 1

10. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 3 b) 1 c) 0 d) 2

11. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 9 b) 27 c) 1 d) 3

12. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A\,e^{3x} + B\,e^{-3x}$ b) $A\cos 3x + B\sin 3x$ c) $A\cosh 3x + B\sinh 3x$ d) $A\,e^{9x} + B\,e^{-9x}$

13. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 9 b) 3/4 c) 6 d) 4/3

14. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 2 b) 0 c) 3 d) 1

15. Which of the following is an even function?
a) x^3 b) cos x c) x d) sin x

16. The derivative of ln(sin x) is:
a) −cot x b) sec x c) tan x d) cot x

17. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Oscillatory b) Conditionally convergent c) Divergent d) Convergent

18. The value of $\int_0^{\pi} \sin x\, dx$ is:
a) 0 b) π c) 1 d) 2

19. Which of the following statements is true?

a) Every bounded sequence is convergent b) Every convergent sequence is bounded c) Every sequence has a limit d) Every monotonic sequence converges

20. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:

a) An even function b) Differentiable at $x = 0$ c) Continuous but not differentiable at $x = 0$ d) Discontinuous at $x = 0$

21. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:

a) It diverges b) 1 c) ln 2 d) e

22. Curl of the gradient of a scalar function is always:

a) Equal to its divergence b) Undefined c) Zero d) Unity

23. $\int_0^1\ 1/(1+x^2)\ dx$ equals:

a) 1 b) π c) $\pi/2$ d) $\pi/4$

24. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?

a) u=(1,1), v=(1,1) b) u=(2,1), v=(1,2) c) u=(1,−1), v=(1,1) d) u=(1,1), v=(3,−1)

25. The eigenvalues of the matrix [[0,1],[1,0]] are:

a) −1, −1 b) 1, 1 c) 1, −1 d) 0, 0

Section II: Statistics (1×25=25)

26. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:

a) Variance of X b) Mean of X c) Kurtosis of X d) Skewness of X

27. A Type I error is also known as:

a) Sampling error b) Alpha error (false positive) c) Beta error d) Standard error

28. The binomial distribution tends to the normal distribution when:

a) $n \to 0$ b) $p \to 0$, $n \to \infty$, np fixed c) $n \to \infty$, p fixed d) $np \to \lambda$ (finite)

29. In time series analysis, the mathematical method most commonly used for measuring trend is:

a) Free-hand curve method b) Semi-average method c) Moving average method d) Least squares method

30. Which measure of central tendency is most affected by extreme values (outliers)?

a) Mean b) Mode c) Median d) None of the above

31. In hypothesis testing, a Type II error occurs when we:

a) Accept H_0 when H_0 is false b) Reject H_1 when H_1 is true c) Reject H_0 when H_0 is true d) None of the above

32. The median of the values 4, 8, 15, 16, 23, 42 is:

a) 15.5 b) 23 c) 15 d) 16

33. In simple random sampling without replacement from a finite population, each unit has:

a) An equal probability of selection b) A probability depending on order drawn c) Zero probability of selection d) An unequal probability of selection

34. If two events A and B are independent, then $P(A \cap B)$ equals:

a) $P(A)\cdot P(B)$ b) $P(A)/P(B)$ c) $P(A) - P(B)$ d) $P(A) + P(B)$

35. If the correlation coefficient $r = 0$ between X and Y, it implies:

a) A negative relationship between X and Y b) No relationship at all between X and Y c) A perfect relationship between X and Y d) No linear relationship between X and Y

36. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:

a) $n^2/2$ b) $(n+1)/2$ c) $n/2$ d) $(n-1)/2$

37. The statistical test generally used to test association between two independent categorical variables is:

a) Chi-square test b) t-test c) Z-test d) F-test

38. The best fitted trend line is the one for which the sum of squares of errors is:
a) Maximum b) Minimum c) Zero d) Negative

39. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The expected number of successes in the sample c) The variance d) The population mean

40. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Geometric mean b) Median c) Arithmetic mean d) Harmonic mean

41. The coefficient of determination R^2 measures:
a) The total unexplained variation in the model b) The proportion of variation in the dependent variable explained by the independent variable c) The proportion of variation in the independent variable explained by the dependent variable d) None of the above

42. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 6 b) 4 c) 3 d) 5

43. Which distribution is used for testing the equality of two population variances?
a) F-distribution b) Normal distribution c) t-distribution d) Chi-square distribution

44. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Positive c) Negative d) Zero

45. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 10 b) 60 c) 125 d) 15

46. The variance of a constant c is:
a) 0 b) c^2 c) c d) Undefined

47. The geometric mean of 2, 4, and 8 is:
a) 4 b) 4.67 c) 8 d) 5

48. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) None of the above b) One-sided upper-tailed test c) Two-tailed test d) One-sided lower-tailed test

49. The standard normal distribution has mean and variance:
a) 0 and 1 b) 1 and 0 c) 1 and 1 d) 0 and 0

50. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) Z-test c) Chi-square test d) t-test

Section III: Computer Science and Information Technology (1×25=25)

51. Which data structure works on the LIFO (Last In First Out) principle?
a) Queue b) Array c) Linked list d) Stack

52. Which class of language is recognized by a pushdown automaton?
a) Context-sensitive language b) Recursively enumerable language c) Regular language d) Context-free language

53. Which of the following is used to uniquely identify a device on a network?
a) URL b) MAC address c) HTML tag d) Domain name

54. Which of the following best describes cloud computing?
a) Delivering computing services (storage, servers, software) over the internet b) Storing data only on local computers c) A type of programming language d) A hardware component

55. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 4NF b) BCNF c) 2NF d) 1NF

56. A deadlock in an operating system occurs when:

a) A process uses too much CPU b) None of the above c) Two or more processes wait indefinitely for resources held by each other d) A process completes execution

57. The time complexity of binary search on a sorted array of n elements is:
a) O(1) b) O(log n) c) O(n log n) d) O(n)

58. The result of $(11010)_2 - (1011)_2$ is:
a) 11100 b) 10101 c) 01110 d) 01111

59. Which of the following is an example of supervised learning?
a) Association rule mining b) K-means clustering c) Principal Component Analysis d) Linear regression

60. Which of the following is an entry-controlled loop?
a) while b) do-while c) Both while and do-while d) None of the above

61. The ability of objects to take on multiple forms is called:
a) Encapsulation b) Inheritance c) Polymorphism d) Abstraction

62. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Abstraction b) Encapsulation c) Polymorphism d) Inheritance

63. In machine learning, overfitting refers to a model that:
a) Performs equally well on all datasets b) Performs poorly on training data c) Cannot be trained at all d) Performs well on training data but poorly on new/unseen data

64. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Memory size c) Lines of code d) Time complexity (Big-O)

65. Which software is most commonly used for spreadsheet-based data analysis?
a) SPSS b) MS Paint c) Photoshop d) MS Excel

66. Which diagram is used to represent the flow of data in structured software analysis?
a) Entity Relationship diagram b) Class diagram c) Data Flow Diagram (DFD) d) Use-case diagram

67. Which of the following statements is true regarding relational database keys?
a) A relation can have multiple candidate keys b) A relation can have only one foreign key c) A relation can have only one candidate key d) A relation can have only one primary key

68. After a rollback, a transaction is in _____ state.
a) Active b) Committed c) Partially committed d) Aborted

69. The OSI model has how many layers?
a) 5 b) 8 c) 6 d) 7

70. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1.1.1 c) 192.168.1 d) 192.168.1.1

71. Which switching technique requires a dedicated path between sender and receiver?
a) Circuit switching b) Packet switching c) None of the above d) Message switching

72. Which of the following is a NoSQL database?
a) Oracle b) PostgreSQL c) MySQL d) MongoDB

73. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, SELECT, WHERE b) FROM, WHERE, SELECT c) SELECT, FROM, WHERE d) WHERE, SELECT, FROM

74. Which SDLC phase focuses on gathering and documenting user requirements?
a) Design b) Requirement Analysis c) Testing d) Maintenance

75. Which of the following is not a Database Management System?
a) Oracle b) MySQL c) PostgreSQL d) Windows

Section IV: Technical English (1×10=10)

76. 'Actions speak louder than words' means:

a) Silence is golden b) Words are more powerful than actions c) What people do matters more than what they say d) Actions are always loud

77. The antonym of 'diligent' is:

a) Punctual b) Hardworking c) Lazy d) Careful

78. "He is the black sheep of the family." The underlined expression has …… meaning.

a) Literal b) Contextual c) Poetic d) Figurative

79. Choose the correct passive voice of 'She is writing a letter.'

a) A letter is written by her b) A letter is being written by her c) A letter has been written by her d) A letter was being written by her

80. He asked me ……

a) that where do I live b) where I lived c) that where I lived d) where I will live

81. "The thief was caught red-handed by the police." This means:

a) The police painted the thief's hand b) The thief's hands were painted red c) The thief was injured d) The thief was caught while committing the crime

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:

a) Governments dislike renewable energy b) Wind energy is the only alternative c) Renewable energy is gaining importance due to environmental benefits d) Fossil fuels are better than renewables

83. The mode of approach in the passage is:

a) Poetic b) Descriptive c) Narrative d) Argumentative

84. According to the passage, one benefit of renewable energy is:

a) Limited availability b) Requiring fossil fuel input c) Low greenhouse gas emissions d) High cost

85. The most appropriate title for the passage is:

a) Renewable Energy: A Sustainable Future b) Solar Power Only c) Climate Change Effects d) The Decline of Fossil Fuels

Section V: Logical Reasoning (1×15=15)

86. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) DPH b) EPG c) EPH d) EOH

87. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Painting Found Near a Tree b) Painting Found Stolen by a Tree c) Tree Stole a Painting d) Tree Found Stolen Painting

88. Find the next term: 1, 4, 9, 16, 25, ___

a) 49 b) 32 c) 30 d) 36

89. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) Water boils at 100°C at sea level b) He scored the highest marks in class c) Could you please close the door? d) The Earth revolves around the Sun

90. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion II follows b) Neither I nor II follows c) Only conclusion I follows d) Both I and II follow

91. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Only conclusion II follows b) Both I and II follow c) Only conclusion I follows d) Neither I nor II follows

92. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."
a) No conclusion b) Both a and b c) so d) since

93. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) II only b) None of the statements is true c) II and III only d) I, II, and III

94. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the uncle of c b) a is the brother of c c) a is the father of c d) a is the son of c

95. Find the missing number: 2, 5, 10, 17, 26, ___
a) 37 b) 38 c) 36 d) 35

96. Which of the following is NOT a useful principle for making scientific progress?
a) Compare similar cases to isolate the relevant difference b) Divide the problem into manageable components c) Actively seek disconfirming evidence as well d) Look only for confirming evidence and ignore disconfirming evidence

97. Find the odd one out:
a) Mango b) Apple c) Carrot d) Banana

98. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Grandfather b) Father c) Uncle d) Brother

99. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?
a) UBCMF b) UBCLF c) TBCMF d) UACMF

100. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Partially follows b) Does not follow c) Follows d) Cannot be determined

Answer Key — Set 16

1	2	3	4	5	6	7	8	9	10
a	c	b	c	d	a	c	a	d	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
d	a	b	c	b	d	c	d	b	c
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	c	d	d	c	a	b	c	d	a

31	32	33	34	35	36	37	38	39	40
a	a	a	a	d	b	a	b	b	a
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
b	d	a	b	c	a	a	b	a	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
d	d	b	a	b	c	b	d	d	a
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	d	d	d	d	c	a	d	d	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	d	b	b	d	c	c	d	b	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
d	c	b	c	a	c	a	d	c	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
c	c	c	a	a	d	c	b	a	c

PRACTICE SET 17

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. A continuous function on a closed and bounded interval [a, b] is always:
a) Differentiable on [a, b] b) Uniformly continuous on [a, b] c) Monotonic on [a, b] d) Unbounded on [a, b]

2. The particular integral of $(D^2 - 1)y = e^x$ is:
a) e^x b) $x\,e^x/2$ c) $e^x/2$ d) $x^2\,e^x$

3. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/34 b) 4/√34 c) 5/√34 d) 3/√34

4. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one but not onto b) Onto but not one-one c) Neither one-one nor onto d) One-one and onto

5. The locus of the equation xz + yz = 0 is:
a) A straight line b) A pair of perpendicular planes c) A pair of parallel planes d) A single plane

6. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 3 b) 1 c) 0 d) 2

7. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Orthogonal b) Singular c) Invertible d) Symmetric

8. Which of the following statements is true?
a) Every bounded sequence is convergent b) Every monotonic sequence converges c) Every convergent sequence is bounded d) Every sequence has a limit

9. The nullity of a 4×4 identity matrix is:
a) Undefined b) 0 c) 4 d) 1

10. The derivative of ln(sin x) is:
a) tan x b) −cot x c) cot x d) sec x

11. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π/4 b) π/2 c) π d) 1

12. A continuous function on a closed and bounded interval [a, b] is always:
a) Uniformly continuous on [a, b] b) Monotonic on [a, b] c) Unbounded on [a, b] d) Differentiable on [a, b]

13. A monotonic decreasing bounded sequence converges to its:
a) Maximum b) Infimum c) Upper bound d) Supremum

14. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) 0 b) ∞ c) e d) 1

15. A square matrix A is called orthogonal if:
a) $A\,A^T = I$ b) $A^2 = I$ c) det(A) = 0 d) $A = A^T$

16. The value of $\int e^x \cos x\,dx$ is:
a) $e^x \sin x + C$ b) $e^x \cos x + C$ c) $(e^x/2)(\sin x + \cos x) + C$ d) $(e^x/2)(\sin x - \cos x) + C$

17. The determinant of a triangular matrix equals:
a) The square of its trace b) The sum of its diagonal elements c) Zero always d) The product of its diagonal elements

18. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x b) x^2 c) 1/x d) ln x

19. The Wronskian of two linearly dependent functions is:

a) −1 b) Undefined c) 0 d) 1

20. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 2 b) -1 c) 0 d) 1

21. The locus of the equation $xz + yz = 0$ is:
a) A single plane b) A pair of parallel planes c) A pair of perpendicular planes d) A straight line

22. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 0 b) e^(2x) c) 4e^(2x) d) −4e^(2x)

23. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Infimum c) Supremum d) Minimum

24. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) 1 b) 0 c) ∞ d) e

25. The general solution of dy/dx = y/x is:
a) y = Cx b) $y = Cx^2$ c) $y = Ce^x$ d) y = C/x

Section II: Statistics (1×25=25)

26. The probability of an impossible event is:
a) 0.5 b) Undefined c) 0 d) 1

27. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 9 c) 2 d) 4

28. For a Poisson distribution, which of the following is true?
a) Mean > Variance b) None of the above c) Mean < Variance d) Mean = Variance

29. The standard deviation of a distribution is always:
a) Undefined b) Negative c) Non-negative d) Zero

30. The sum of squares of deviations is minimum when measured from the:
a) Mean b) Geometric mean c) Median d) Mode

31. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \le a)$ is computed using:
a) $Z = (a-\mu)\sigma$ b) $Z = (a-\mu)/\sqrt{n}$ c) $Z = (a-\mu)/\sigma$ d) $Z = (a-\mu)/\sigma^2$

32. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/2\}$ b) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/2\}$ c) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/8\}$

33. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) (n+1)/2 b) (n−1)/2 c) $n^2/2$ d) n/2

34. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 9 c) 2 d) 4

35. The appropriate statistical test for comparing means across more than two independent groups is:
a) t-test b) Chi-square test c) Z-test d) F-test (ANOVA)

36. The sum of squares of deviations is minimum when measured from the:
a) Median b) Geometric mean c) Mean d) Mode

37. Which distribution is used for testing the equality of two population variances?
a) F-distribution b) t-distribution c) Normal distribution d) Chi-square distribution

38. The chi-square test statistic can never be:
a) Positive b) Negative c) A decimal value d) Zero

39. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:

a) 0.3 b) 0.2 c) 0.1 d) −0.2

40. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided lower-tailed test b) None of the above c) Two-tailed test d) One-sided upper-tailed test

41. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c − 2 b) r + c c) (r−1)(c−1) d) rc

42. In simple random sampling without replacement from a finite population, each unit has:
a) An equal probability of selection b) Zero probability of selection c) An unequal probability of selection d) A probability depending on order drawn

43. The coefficient of variation is computed using the formula:
a) (mean/s.d.) × 100 b) 100/(mean × s.d.) c) (s.d./mean) × 100 d) (mean × s.d.)/100

44. The p-value in hypothesis testing represents:
a) The probability of observing the data (or more extreme), given H_0 is true b) The probability that H_1 is true c) The significance level itself d) The probability that H_0 is true

45. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mean b) None of the above c) Mode d) Median

46. The standard normal distribution has mean and variance:
a) 0 and 1 b) 0 and 0 c) 1 and 0 d) 1 and 1

47. The correlation coefficient r always lies between:
a) 0 and 1 b) −1 and 1 c) 0 and ∞ d) −∞ and ∞

48. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ^2 and λ b) λ and λ c) $1/\lambda$ and $1/\lambda^2$ d) λ and λ^2

49. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The variance c) The population mean d) The expected number of successes in the sample

50. In hypothesis testing, a Type II error occurs when we:
a) Reject H_0 when H_0 is true b) Accept H_0 when H_0 is false c) Reject H_1 when H_1 is true d) None of the above

Section III: Computer Science and Information Technology (1×25=25)

51. Which layer is responsible for routing data across different networks?
a) Application layer b) Network/Internet layer c) Data link layer d) Physical layer

52. Recursion in programming is best described as:
a) A function calling itself to solve smaller instances of a problem b) A loop with no exit condition c) A function that never returns d) A data structure

53. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Quick sort c) Bubble sort d) Selection sort

54. Which of the following is a compiled language?
a) C b) JavaScript c) PHP d) Python

55. A firewall is primarily used to:
a) Store data backups b) Control and filter network traffic for security c) Compress files d) Speed up an internet connection

56. Which of the following is a valid IPv4 address?
a) 192.168.1.1.1 b) 192.168.1.1 c) 192.168.1 d) 192.168.1.256

57. Which of the following is a NoSQL database?
a) Oracle b) PostgreSQL c) MongoDB d) MySQL

58. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) SELECT, FROM, WHERE c) WHERE, SELECT, FROM d) FROM, SELECT, WHERE

59. The time complexity of binary search on a sorted array of n elements is:
a) O(n log n) b) O(log n) c) O(1) d) O(n)

60. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 10 b) 6 c) 4 d) 5

61. Which layer is responsible for routing data across different networks?
a) Physical layer b) Data link layer c) Application layer d) Network/Internet layer

62. Which of the following statements is executed by the preprocessor?
a) printf("Hello"); b) return 0; c) void main() d) #define PI 3.14

63. Which normal form removes partial dependency on a composite primary key?
a) 1NF b) 2NF c) 3NF d) BCNF

64. Which system development approach is best suited when requirements evolve continuously?
a) V-model b) Agile c) Waterfall d) None of the above

65. Which class of language is recognized by a pushdown automaton?
a) Context-free language b) Regular language c) Recursively enumerable language d) Context-sensitive language

66. Which of the following is an example of secondary memory?
a) Hard disk b) Register c) RAM d) Cache

67. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Inheritance b) Abstraction c) Encapsulation d) Polymorphism

68. Which diagram is used to represent the flow of data in structured software analysis?
a) Entity Relationship diagram b) Data Flow Diagram (DFD) c) Class diagram d) Use-case diagram

69. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Lines of code c) Time complexity (Big-O) d) Memory size

70. Which of the following information is required to normalize a relation into 3NF?
a) Multivalued dependency b) Functional dependency c) None of the above d) Join dependency

71. HTTP stands for:
a) Host Transfer Text Protocol b) High Transfer Text Protocol c) HyperText Transfer Protocol d) HyperText Transmission Process

72. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 1NF b) 2NF c) BCNF d) 4NF

73. Which of the following is not a Database Management System?
a) Windows b) Oracle c) MySQL d) PostgreSQL

74. Which of the following best describes cloud computing?
a) A hardware component b) A type of programming language c) Storing data only on local computers d) Delivering computing services (storage, servers, software) over the internet

75. The ability of objects to take on multiple forms is called:
a) Inheritance b) Polymorphism c) Abstraction d) Encapsulation

Section IV: Technical English (1×10=10)

76. Choose the word closest in meaning to 'meticulous':
a) Careful and precise b) Careless c) Confused d) Quick

77. Choose the correctly spelled word:
a) Receiv b) Recieve c) Receive d) Receve

78. Which of the following is a compound sentence?
a) She sings well. b) Singing well is her passion. c) Because she practices, she sings well. d) She sings well, and she dances gracefully.

79. Choose the correctly punctuated sentence:
a) It is'nt a nice day b) Its a nice day c) It's a nice day d) Its' a nice day

80. He asked me ……
a) that where I lived b) where I will live c) that where do I live d) where I lived

81. 'He is used to _____ early.'
a) waking b) waken c) wake d) woke

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:
a) Job displacement and data privacy b) AI is only used in healthcare c) AI is too expensive d) AI cannot analyze data

83. According to the passage, what do experts recommend?
a) Banning AI completely b) Using AI only in finance c) Ignoring privacy concerns d) A balanced approach combining innovation and ethical safeguards

84. The tone of the passage is:
a) Balanced and analytical b) Purely critical c) Sarcastic d) Purely promotional

85. The most suitable title for the passage is:
a) Artificial Intelligence: Opportunities and Challenges b) The Dangers of Technology c) Finance in the Modern Age d) Healthcare Systems Today

Section V: Logical Reasoning (1×15=15)

86. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?
a) EPH b) EOH c) EPG d) DPH

87. Find the missing number: 2, 5, 10, 17, 26, ___
a) 38 b) 36 c) 35 d) 37

88. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 98 b) 120 c) 84 d) 112

89. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Only conclusion I follows b) Both I and II follow c) Neither I nor II follows d) Only conclusion II follows

90. Circle is to Sphere as Square is to:
a) Cylinder b) Cube c) Cone d) Rectangle

91. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) The Earth revolves around the Sun b) Water boils at 100°C at sea level c) He scored the highest marks in class d) Could you please close the door?

92. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Neither I nor II follows b) Both I and II follow c) Only conclusion I follows d) Only conclusion II follows

93. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 42 b) 40 c) 44 d) 36

94. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Only conclusion I follows b) Both I and II follow c) Only conclusion II follows d) Neither I nor II follows

95. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 62 b) 63 c) 64 d) 61

96. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?
a) TBCMF b) UBCLF c) UACMF d) UBCMF

97. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."
a) No conclusion b) so c) Both a and b d) since

98. All cats are animals. No animal is a plant. Therefore:
a) All plants are animals b) No conclusion can be drawn c) No cat is a plant d) Some cats are plants

99. Which of the following is NOT a useful principle for making scientific progress?
a) Actively seek disconfirming evidence as well b) Compare similar cases to isolate the relevant difference c) Divide the problem into manageable components d) Look only for confirming evidence and ignore disconfirming evidence

100. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 24 b) 18 c) 22 d) 20

Answer Key — Set 17

1	2	3	4	5	6	7	8	9	10
b	b	c	a	b	d	b	c	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	a	b	b	a	c	d	a	c	d
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	a	b	d	a	c	c	d	c	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
c	c	a	c	d	c	a	b	b	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	c	a	a	a	b	b	d	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	a	b	a	b	b	c	a	b	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	d	b	b	a	a	a	b	c	b
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	c	a	d	b	a	c	d	c	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	a	d	a	a	a	d	d	a	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	c	a	a	b	d	b	c	d	d

PRACTICE SET 18

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 1 b) 0 c) 3 d) 2

2. The Laplace transform of sinh(3t) is:
a) $3/(s^2+9)$ b) $s/(s^2+9)$ c) $3/(s^2-9)$ d) $s/(s^2-9)$

3. Which of the following is an even function?
a) sin x b) cos x c) x d) x^3

4. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) It diverges b) 1 c) ln 2 d) e

5. The particular integral of $(D^2 - 1)y = e^x$ is:
a) e^x b) $x^2 e^x$ c) $e^x/2$ d) $x\, e^x/2$

6. Which of the following sets is countable?
a) Real numbers b) Irrational numbers c) Rational numbers d) The interval [0, 1]

7. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 0, 0 b) 1, −1 c) −1, −1 d) 1, 1

8. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 25 b) 5 c) 3125 d) 120

9. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,−1), v=(1,1) b) u=(1,1), v=(3,−1) c) u=(2,1), v=(1,2) d) u=(1,1), v=(1,1)

10. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) An oblique tangent c) A vertical tangent d) A horizontal tangent

11. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) 1 b) Undefined c) 0 d) ∞

12. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 6 b) 4/3 c) 9 d) 3/4

13. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1 b) 0 c) 2 d) 3

14. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) Neither one-one nor onto b) One-one and onto c) One-one but not onto d) Onto but not one-one

15. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 1 b) 9 c) 27 d) 3

16. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/34 b) $3/\sqrt{34}$ c) $4/\sqrt{34}$ d) $5/\sqrt{34}$

17. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I and III only b) II only c) III only d) I only

18. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 4, 2 b) 2, −2 c) 3, 3 d) 6, 0

19. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:

a) Continuous but not differentiable at x = 0 b) Discontinuous at x = 0 c) Differentiable at x = 0 d) An even function

20. The value of $\int_0^{\pi} \sin x \, dx$ is:
a) 1 b) 0 c) π d) 2

21. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Zero c) Undefined d) Unity

22. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A + Bx$ b) $y = Ae^{ix}$ c) $y = Ae^{x} + Be^{-x}$ d) $y = A \cos x + B \sin x$

23. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A e^{3x} + B e^{-3x}$ b) $A \cos 3x + B \sin 3x$ c) $A e^{9x} + B e^{-9x}$ d) $A \cosh 3x + B \sinh 3x$

24. The series $\Sigma 1/(n \ln n)$, $n \geq 2$, is:
a) Oscillatory b) Conditionally convergent c) Divergent d) Convergent

25. The sum of the series Σ (from n=5 to ∞) $2^{(n+1)}/3^n$ is:
a) $6(2/3)^5$ b) $2(2/3)^5$ c) $3(2/3)^5$ d) $6(2/3)^4$

Section II: Statistics (1×25=25)

26. The geometric mean of 2, 4, and 8 is:
a) 4.67 b) 8 c) 5 d) 4

27. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Chebyshev's Inequality b) Central Limit Theorem c) Bayes' Theorem d) Law of Large Numbers

28. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Cannot be determined b) Narrower c) Wider d) The same width

29. The statistical test generally used to test association between two independent categorical variables is:
a) Chi-square test b) Z-test c) F-test d) t-test

30. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) - P(B)$ b) $P(A) \cdot P(B)$ c) $P(A) + P(B)$ d) $P(A)/P(B)$

31. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 3 b) 4 c) 6 d) 5

32. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 10 b) 60 c) 125 d) 15

33. The standard deviation of a distribution is always:
a) Negative b) Zero c) Non-negative d) Undefined

34. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Least squares method b) Semi-average method c) Moving average method d) Free-hand curve method

35. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Zero c) Negative d) Positive

36. The coefficient of determination R^2 measures:
a) The total unexplained variation in the model b) None of the above c) The proportion of variation in the independent variable explained by the dependent variable d) The proportion of variation in the dependent variable explained by the independent variable

37. The probability of an impossible event is:
a) 0.5 b) Undefined c) 0 d) 1

38. For a Poisson distribution, which of the following is true?
a) Mean = Variance b) Mean < Variance c) Mean > Variance d) None of the above

39. The binomial distribution tends to the normal distribution when:
a) $n \to 0$ b) $n \to \infty$, p fixed c) $p \to 0$, $n \to \infty$, np fixed d) $np \to \lambda$ (finite)

40. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 1/8 b) 5/8 c) 3/8 d) 1/2

41. The best fitted trend line is the one for which the sum of squares of errors is:
a) Zero b) Maximum c) Negative d) Minimum

42. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Median b) Arithmetic mean c) Harmonic mean d) Geometric mean

43. A Type I error is also known as:
a) Beta error b) Alpha error (false positive) c) Sampling error d) Standard error

44. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15 b) 16 c) 23 d) 15.5

45. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Variance of X b) Kurtosis of X c) Mean of X d) Skewness of X

46. If the two observations are 15 and −15, then their harmonic mean is:
a) −15 b) 15 c) ∞ (undefined) d) 0

47. In stratified sampling, the population is divided into:
a) Equal-sized random groups b) Homogeneous subgroups (strata) c) Systematic intervals d) Random clusters

48. If the correlation coefficient r = 0 between X and Y, it implies:
a) No linear relationship between X and Y b) No relationship at all between X and Y c) A perfect relationship between X and Y d) A negative relationship between X and Y

49. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_x(0.5)^x$ b) ${}_nC_x(0.5)^{(n-x)}$ c) ${}_nC_n(0.5)^x$ d) ${}_nC_x(0.5)^n$

50. The variance of a constant c is:
a) 0 b) c c) c^2 d) Undefined

Section III: Computer Science and Information Technology (1×25=25)

51. Which SDLC phase focuses on gathering and documenting user requirements?
a) Requirement Analysis b) Testing c) Maintenance d) Design

52. A deadlock in an operating system occurs when:
a) None of the above b) A process uses too much CPU c) Two or more processes wait indefinitely for resources held by each other d) A process completes execution

53. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Paint b) Photoshop c) MS Excel d) SPSS

54. Round-robin scheduling is the preemptive version of:
a) First Come First Serve (FCFS) b) Shortest Job First c) Priority Scheduling d) None of the above

55. Which of the following is a compiled language?
a) JavaScript b) PHP c) C d) Python

56. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) TRUNCATE c) DROP d) DELETE

57. A firewall is primarily used to:

a) Compress files b) Speed up an internet connection c) Store data backups d) Control and filter network traffic for security

58. After a rollback, a transaction is in _____ state.
a) Aborted b) Committed c) Active d) Partially committed

59. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.0 b) 255.255.255.128 c) 255.255.255.224 d) 255.255.255.192

60. Which data structure works on the LIFO (Last In First Out) principle?
a) Queue b) Stack c) Array d) Linked list

61. Which protocol is used to send email?
a) SMTP b) FTP c) SNMP d) HTTP

62. Which of the following is an entry-controlled loop?
a) do-while b) None of the above c) Both while and do-while d) while

63. Which of the following statements is true regarding relational database keys?
a) A relation can have only one primary key b) A relation can have only one foreign key c) A relation can have only one candidate key d) A relation can have multiple candidate keys

64. IP in the context of networking stands for:
a) Information Packet b) Interface Path c) Internal Process d) Internet Protocol

65. In machine learning, overfitting refers to a model that:
a) Cannot be trained at all b) Performs poorly on training data c) Performs equally well on all datasets d) Performs well on training data but poorly on new/unseen data

66. Recursion in programming is best described as:
a) A function calling itself to solve smaller instances of a problem b) A function that never returns c) A data structure d) A loop with no exit condition

67. The OSI model has how many layers?
a) 6 b) 8 c) 5 d) 7

68. A primary key can contain:
a) Only NULL values b) Duplicate values c) NULL values d) Neither duplicate nor NULL values

69. Which of the following is used to uniquely identify a device on a network?
a) URL b) MAC address c) HTML tag d) Domain name

70. Which of the following is an example of supervised learning?
a) K-means clustering b) Association rule mining c) Principal Component Analysis d) Linear regression

71. The result of $(11010)_2 - (1011)_2$ is:
a) 01110 b) 11100 c) 10101 d) 01111

72. Which sorting algorithm has the best average-case time complexity among the following?
a) Selection sort b) Quick sort c) Bubble sort d) Insertion sort

73. Which switching technique requires a dedicated path between sender and receiver?
a) Message switching b) None of the above c) Circuit switching d) Packet switching

74. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Fluorescence b) Persistence c) Refresh rate d) Phosphorescence

75. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Tree b) Stack c) Queue d) Graph

Section IV: Technical English (1×10=10)

76. Identify the correctly punctuated sentence:

a) Although it was raining, we went for a walk. b) Although it was, raining we went for a walk. c) Although, it was raining we went for a walk. d) Although it was raining we, went for a walk.

77. Choose the correct passive voice of 'She is writing a letter.'

a) A letter is written by her b) A letter was being written by her c) A letter is being written by her d) A letter has been written by her

78. Choose the correct form: 'One of the students _____ absent today.'

a) have been b) are c) were d) is

79. 'By the time we arrived, the movie _____.'

a) already starts b) already started c) has already started d) had already started

80. Choose the correctly spelled word:

a) Receve b) Receive c) Recieve d) Receiv

81. The phrase 'in the nick of time' means:

a) In the near future b) At the beginning c) At the very last possible moment d) Too late

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:

a) None of the above b) Education, healthcare, and employment c) Only entertainment d) Agriculture

83. Which of the following is mentioned as a challenge of urbanization?

a) Abundant farmland b) Traffic congestion c) Low population d) Excess housing

84. What does the passage suggest is essential for livable cities?

a) Reducing population to zero b) Sustainable urban planning c) Removing green spaces d) Banning public transport

85. The passage is primarily about:

a) Global warming b) The opportunities and challenges of urbanization c) Rural life d) The history of cities

Section V: Logical Reasoning (1×15=15)

86. Choose the word that does NOT belong with the others:

a) Square b) Circle c) Cube d) Triangle

87. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 18 b) 20 c) 24 d) 22

88. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.

If the above are true, which must also be true?

I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly

a) None of the statements is true b) II and III only c) I, II, and III d) II only

89. Read the following carefully:

I. P+Q means P is the son of Q

II. P−Q means P is the wife of Q

III. P×Q means P is the brother of Q

IV. P÷Q means P is the mother of Q

V. P=Q means P is the sister of Q

What does a×b÷c mean?

a) a is the son of c b) a is the father of c c) a is the brother of c d) a is the uncle of c

90. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Mother b) Aunt c) Sister d) Daughter

91. Find the next term: 1, 4, 9, 16, 25, ___

a) 30 b) 49 c) 36 d) 32

92. Statement: All students who study hard get good grades. Ram studies hard.

Conclusion: Ram gets good grades.

Does the conclusion follow?

a) Partially follows b) Follows c) Cannot be determined d) Does not follow

93. Fill in the blank: MBN NBO OBP PBQ _____

a) QBQ b) RBQ c) PBR d) QBR

94. Find the odd one out:

a) Banana b) Carrot c) Mango d) Apple

95. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 65 b) 67 c) 61 d) 63

96. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Father b) Uncle c) Grandfather d) Brother

97. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) winbo b) bota c) ligowin d) bowin

98. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) All Lazzies are Bloops b) All Bloops are Lazzies c) Some Lazzies are not Razzies d) No Bloops are Lazzies

99. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Painting Found Near a Tree b) Tree Stole a Painting c) Tree Found Stolen Painting d) Painting Found Stolen by a Tree

100. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Monday b) Saturday c) Sunday d) Friday

Answer Key — Set 18

1	2	3	4	5	6	7	8	9	10
c	c	b	c	d	c	b	d	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	d	c	c	d	d	a	a	a	d
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	d	a	c	a	d	b	c	a	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	c	c	a	d	d	c	a	b	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
d	d	b	d	a	c	b	a	d	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	c	c	a	c	c	d	a	d	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
a	d	d	d	d	a	d	d	b	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	b	c	a	c	a	c	d	d	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	b	b	b	b	c	b	b	d	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
c	b	d	b	a	a	d	b	a	b

PRACTICE SET 19

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The value of $\int_0^{\pi} \sin x\, dx$ is:
a) π b) 1 c) 2 d) 0

2. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Oscillatory b) Conditionally convergent c) Divergent d) Convergent

3. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) 1 b) Undefined c) ∞ d) 0

4. $\int_0^1 1/(1+x^2)\, dx$ equals:
a) π b) 1 c) π/4 d) π/2

5. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 5 b) 3125 c) 25 d) 120

6. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 1 b) 2 c) -1 d) 0

7. If $y = e^{(2x)}$, then the value of $y'' - 4y' + 4y$ is:
a) 0 b) $e^{(2x)}$ c) $4e^{(2x)}$ d) $-4e^{(2x)}$

8. A continuous function on a closed and bounded interval [a, b] is always:
a) Unbounded on [a, b] b) Differentiable on [a, b] c) Monotonic on [a, b] d) Uniformly continuous on [a, b]

9. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A \cos x + B \sin x$ b) $y = Ae^x + Be^{-x}$ c) $y = A + Bx$ d) $y = Ae^{ix}$

10. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x^2 b) ln x c) 1/x d) x

11. The sequence $b_n = \Sigma_{k=1}^{n}\, 1/(n+k)$ converges to:
a) It diverges b) e c) 1 d) ln 2

12. The determinant of a triangular matrix equals:
a) The product of its diagonal elements b) The square of its trace c) Zero always d) The sum of its diagonal elements

13. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(1,1) b) u=(1,−1), v=(1,1) c) u=(2,1), v=(1,2) d) u=(1,1), v=(3,−1)

14. The sum of the series Σ (from n=5 to ∞) $2^{(n+1)}/3^n$ is:
a) $2(2/3)^5$ b) $6(2/3)^4$ c) $6(2/3)^5$ d) $3(2/3)^5$

15. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 27 b) 3 c) 1 d) 9

16. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) 1 b) 0 c) e d) ∞

17. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I and III only b) II only c) I only d) III only

18. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 1 b) 3 c) 0 d) 2

19. The value of $\int e^x \cos x \, dx$ is:
a) $(e^x/2)(\sin x - \cos x) + C$ b) $e^x \sin x + C$ c) $e^x \cos x + C$ d) $(e^x/2)(\sin x + \cos x) + C$

20. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $e^x/2$ b) $x\, e^x/2$ c) $x^2 e^x$ d) e^x

21. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, 1 b) 1, −1 c) 0, 0 d) −1, −1

22. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) $3/\sqrt{34}$ b) $5/34$ c) $4/\sqrt{34}$ d) $5/\sqrt{34}$

23. Which of the following sets is countable?
a) Real numbers b) Irrational numbers c) The interval [0, 1] d) Rational numbers

24. The Laplace transform of sinh(3t) is:
a) $3/(s^2+9)$ b) $s/(s^2-9)$ c) $3/(s^2-9)$ d) $s/(s^2+9)$

25. The Wronskian of two linearly dependent functions is:
a) 1 b) 0 c) Undefined d) −1

Section II: Statistics (1×25=25)

26. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 4 b) 5 c) 3 d) 6

27. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Mean of X b) Kurtosis of X c) Variance of X d) Skewness of X

28. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided upper-tailed test b) One-sided lower-tailed test c) None of the above d) Two-tailed test

29. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Least squares method b) Moving average method c) Semi-average method d) Free-hand curve method

30. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) \cdot P(B)$ b) $P(A) + P(B)$ c) $P(A)/P(B)$ d) $P(A) - P(B)$

31. The standard deviation of a distribution is always:
a) Undefined b) Non-negative c) Negative d) Zero

32. The coefficient of determination R^2 measures:
a) None of the above b) The proportion of variation in the independent variable explained by the dependent variable c) The proportion of variation in the dependent variable explained by the independent variable d) The total unexplained variation in the model

33. If the correlation coefficient r = 0 between X and Y, it implies:
a) No relationship at all between X and Y b) A negative relationship between X and Y c) A perfect relationship between X and Y d) No linear relationship between X and Y

34. The coefficient of variation is computed using the formula:
a) 100/(mean × s.d.) b) (mean × s.d.)/100 c) (s.d./mean) × 100 d) (mean/s.d.) × 100

35. The correlation coefficient r always lies between:
a) 0 and 1 b) 0 and ∞ c) −1 and 1 d) −∞ and ∞

36. The appropriate statistical test for comparing means across more than two independent groups is:
a) Chi-square test b) F-test (ANOVA) c) t-test d) Z-test

37. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi}) \exp\{-(x-10)^2/2\}$ b) $1/\sqrt{2\pi} \exp\{-(x-10)^2/2\}$ c) $1/\sqrt{2\pi} \exp\{-(x-10)^2/8\}$ d) $1/(2\sqrt{2\pi}) \exp\{-(x-10)^2/8\}$

38. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The population mean c) The expected number of successes in the sample d) The variance

39. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sigma$ b) $Z = (a-\mu)/\sqrt{n}$ c) $Z = (a-\mu)/\sigma^2$ d) $Z = (a-\mu)\sigma$

40. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Harmonic mean b) Geometric mean c) Arithmetic mean d) Median

41. The variance of a constant c is:
a) c b) Undefined c) c^2 d) 0

42. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) n/2 b) $n^2/2$ c) (n−1)/2 d) (n+1)/2

43. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 60 b) 15 c) 125 d) 10

44. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15 b) 15.5 c) 16 d) 23

45. For a Poisson distribution, which of the following is true?
a) Mean < Variance b) None of the above c) Mean = Variance d) Mean > Variance

46. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mode b) Median c) Mean d) None of the above

47. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 1/8 c) 1/2 d) 5/8

48. The chi-square test statistic can never be:
a) Positive b) Zero c) A decimal value d) Negative

49. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.1 b) −0.2 c) 0.3 d) 0.2

50. The geometric mean of 2, 4, and 8 is:
a) 4.67 b) 4 c) 5 d) 8

Section III: Computer Science and Information Technology (1×25=25)

51. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) WHERE, SELECT, FROM d) SELECT, FROM, WHERE

52. Round-robin scheduling is the preemptive version of:
a) Priority Scheduling b) None of the above c) First Come First Serve (FCFS) d) Shortest Job First

53. Which sorting algorithm has the best average-case time complexity among the following?
a) Selection sort b) Quick sort c) Bubble sort d) Insertion sort

54. Which of the following is a compiled language?
a) JavaScript b) C c) Python d) PHP

55. The ability of objects to take on multiple forms is called:
a) Encapsulation b) Inheritance c) Polymorphism d) Abstraction

56. In machine learning, overfitting refers to a model that:
a) Cannot be trained at all b) Performs equally well on all datasets c) Performs poorly on training data d) Performs well on training data but poorly on new/unseen data

57. IP in the context of networking stands for:
a) Interface Path b) Internal Process c) Information Packet d) Internet Protocol

58. Which of the following is used to uniquely identify a device on a network?
a) Domain name b) HTML tag c) MAC address d) URL

59. The OSI model has how many layers?
a) 8 b) 6 c) 7 d) 5

60. A firewall is primarily used to:
a) Store data backups b) Compress files c) Speed up an internet connection d) Control and filter network traffic for security

61. Recursion in programming is best described as:
a) A function calling itself to solve smaller instances of a problem b) A function that never returns c) A loop with no exit condition d) A data structure

62. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Fluorescence c) Persistence d) Refresh rate

63. Which of the following information is required to normalize a relation into 3NF?
a) Multivalued dependency b) Functional dependency c) Join dependency d) None of the above

64. Which software is most commonly used for spreadsheet-based data analysis?
a) Photoshop b) SPSS c) MS Paint d) MS Excel

65. Which of the following is an example of supervised learning?
a) Association rule mining b) K-means clustering c) Principal Component Analysis d) Linear regression

66. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) BCNF b) 2NF c) 1NF d) 4NF

67. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.192 b) 255.255.255.224 c) 255.255.255.128 d) 255.255.255.0

68. Which SDLC phase focuses on gathering and documenting user requirements?
a) Testing b) Requirement Analysis c) Maintenance d) Design

69. Which of the following statements is true regarding relational database keys?
a) A relation can have only one candidate key b) A relation can have only one foreign key c) A relation can have only one primary key d) A relation can have multiple candidate keys

70. Which of the following is an entry-controlled loop?
a) do-while b) while c) None of the above d) Both while and do-while

71. The time complexity of binary search on a sorted array of n elements is:
a) O(n log n) b) O(n) c) O(log n) d) O(1)

72. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) DELETE c) TRUNCATE d) DROP

73. Which of the following is a NoSQL database?
a) Oracle b) MongoDB c) PostgreSQL d) MySQL

74. Which protocol is used to send email?
a) SNMP b) SMTP c) FTP d) HTTP

75. HTTP stands for:
a) High Transfer Text Protocol b) Host Transfer Text Protocol c) HyperText Transfer Protocol d) HyperText Transmission Process

Section IV: Technical English (1×10=10)

76. Which of the following is a compound sentence?

a) She sings well, and she dances gracefully. b) Because she practices, she sings well. c) Singing well is her passion. d) She sings well.

77. The synonym of 'abundant' is:

a) Plentiful b) Limited c) Scarce d) Rare

78. The idiom 'to hit the nail on the head' means:

a) To work with tools b) To hurt someone c) To make a mistake d) To say or do something exactly right

79. Choose the correct comparative form: 'This problem is _____ than the previous one.'

a) more difficult b) difficultest c) difficult d) most difficult

80. Choose the correctly punctuated sentence:

a) Its' a nice day b) It is'nt a nice day c) It's a nice day d) Its a nice day

81. The antonym of 'diligent' is:

a) Punctual b) Hardworking c) Careful d) Lazy

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:

a) Wind energy is the only alternative b) Governments dislike renewable energy c) Fossil fuels are better than renewables d) Renewable energy is gaining importance due to environmental benefits

83. The mode of approach in the passage is:

a) Poetic b) Narrative c) Argumentative d) Descriptive

84. According to the passage, one benefit of renewable energy is:

a) Requiring fossil fuel input b) High cost c) Low greenhouse gas emissions d) Limited availability

85. The most appropriate title for the passage is:

a) The Decline of Fossil Fuels b) Renewable Energy: A Sustainable Future c) Solar Power Only d) Climate Change Effects

Section V: Logical Reasoning (1×15=15)

86. Choose the word that does NOT belong with the others:

a) Cube b) Circle c) Triangle d) Square

87. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.

Conclusion II: The economic slowdown affected the company.

Which one is true?

a) Only conclusion I follows b) Only conclusion II follows c) Neither I nor II follows d) Both I and II follow

88. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UACMF b) TBCMF c) UBCLF d) UBCMF

89. Statement: Regular exercise improves cardiovascular health and mental well-being.

Conclusion I: People who exercise regularly tend to be healthier.

Conclusion II: People should exercise every day for one hour.

Which one is true?

a) Only conclusion I follows b) Only conclusion II follows c) Both I and II follow d) Neither I nor II follows

90. Read the following carefully:

I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the son of c b) a is the uncle of c c) a is the father of c d) a is the brother of c

91. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) All Bloops are Lazzies b) All Lazzies are Bloops c) No Bloops are Lazzies d) Some Lazzies are not Razzies

92. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 84 b) 112 c) 120 d) 98

93. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?
a) Painting Found Stolen by a Tree b) Tree Stole a Painting c) Painting Found Near a Tree d) Tree Found Stolen Painting

94. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion I follows b) Neither I nor II follows c) Both I and II follow d) Only conclusion II follows

95. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) None of the statements is true b) II and III only c) II only d) I, II, and III

96. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) ligowin b) bota c) winbo d) bowin

97. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Partially follows b) Does not follow c) Follows d) Cannot be determined

98. Find the missing number: 2, 5, 10, 17, 26, ___
a) 35 b) 36 c) 37 d) 38

99. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?
a) EOH b) EPH c) EPG d) DPH

100. All cats are animals. No animal is a plant. Therefore:
a) Some cats are plants b) No cat is a plant c) No conclusion can be drawn d) All plants are animals

Answer Key — Set 19

1	2	3	4	5	6	7	8	9	10
c	c	a	c	d	a	a	d	a	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
d	a	d	c	b	c	a	d	d	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	d	d	c	b	b	c	a	a	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	c	d	c	c	b	d	c	a	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**

d	d	c	b	c	c	a	d	d	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	c	b	b	c	d	d	c	c	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
a	b	b	d	d	a	a	b	d	b
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	d	b	b	c	a	a	d	a	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
d	d	d	c	b	a	a	d	a	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	b	c	a	b	d	c	c	b	b

PRACTICE SET 20

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The general solution of dy/dx = y/x is:
a) $y = Ce^x$ b) $y = C/x$ c) $y = Cx^2$ d) $y = Cx$

2. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 2 b) 1 c) 3 d) 0

3. The nullity of a 4×4 identity matrix is:
a) Undefined b) 0 c) 1 d) 4

4. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 3, 3 b) 6, 0 c) 4, 2 d) 2, −2

5. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Minimum b) Infimum c) Supremum d) Maximum

6. The locus of the equation xz + yz = 0 is:
a) A pair of perpendicular planes b) A straight line c) A single plane d) A pair of parallel planes

7. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Undefined c) Zero d) Unity

8. Let $f(x) = x^2$ for $x \leq 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Continuous but not differentiable at x = 0 b) Discontinuous at x = 0 c) An even function d) Differentiable at x = 0

9. Which of the following is an even function?
a) sin x b) x^3 c) x d) cos x

10. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one but not onto b) Neither one-one nor onto c) Onto but not one-one d) One-one and onto

11. Which of the following statements is true?
a) Every bounded sequence is convergent b) Every monotonic sequence converges c) Every sequence has a limit d) Every convergent sequence is bounded

12. The curve y = x^(1/3) at (0, 0) has:
a) An oblique tangent b) A vertical tangent c) No tangent d) A horizontal tangent

13. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Singular b) Symmetric c) Orthogonal d) Invertible

14. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) ∞ b) 0 c) e d) 1

15. The derivative of ln(sin x) is:
a) sec x b) −cot x c) tan x d) cot x

16. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cos3x + B sin3x b) A cosh3x + B sinh3x c) $A\, e^{9x} + B\, e^{-9x}$ d) $A\, e^{3x} + B\, e^{-3x}$

17. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 4/3 b) 3/4 c) 6 d) 9

18. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 3 b) 2 c) 0 d) 1

19. A square matrix A is called orthogonal if:

a) $A = A^T$ b) $A\,A^T = I$ c) $\det(A) = 0$ d) $A^2 = I$

20. A monotonic decreasing bounded sequence converges to its:
a) Infimum b) Upper bound c) Maximum d) Supremum

21. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 9 b) 3/4 c) 4/3 d) 6

22. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) Onto but not one-one b) One-one but not onto c) One-one and onto d) Neither one-one nor onto

23. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x b) x^2 c) ln x d) 1/x

24. The locus of the equation $xz + yz = 0$ is:
a) A single plane b) A straight line c) A pair of perpendicular planes d) A pair of parallel planes

25. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Symmetric b) Orthogonal c) Invertible d) Singular

Section II: Statistics (1×25=25)

26. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) rc b) r + c − 2 c) (r−1)(c−1) d) r + c

27. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) 1/λ and $1/\lambda^2$ b) λ and λ c) λ and λ^2 d) λ^2 and λ

28. The sum of squares of deviations is minimum when measured from the:
a) Median b) Geometric mean c) Mode d) Mean

29. The probability of an impossible event is:
a) Undefined b) 1 c) 0.5 d) 0

30. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Zero b) Negative c) Positive d) Unity

31. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) Wider c) Cannot be determined d) The same width

32. A Type I error is also known as:
a) Alpha error (false positive) b) Sampling error c) Standard error d) Beta error

33. Which distribution is used for testing the equality of two population variances?
a) F-distribution b) Normal distribution c) t-distribution d) Chi-square distribution

34. The statistical test generally used to test association between two independent categorical variables is:
a) Chi-square test b) t-test c) Z-test d) F-test

35. In hypothesis testing, a Type II error occurs when we:
a) Reject H_1 when H_1 is true b) None of the above c) Reject H_0 when H_0 is true d) Accept H_0 when H_0 is false

36. In a binomial distribution, if the probability of success $\pi = 0.5$, then Pr(X=x) is given by:
a) ${}_nC_n(0.5)^x$ b) ${}_nC_x(0.5)^{(n-x)}$ c) ${}_nC_x(0.5)^n$ d) ${}_nC_x(0.5)^x$

37. In simple random sampling without replacement from a finite population, each unit has:
a) A probability depending on order drawn b) An unequal probability of selection c) Zero probability of selection
d) An equal probability of selection

38. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 9 c) 4 d) 2

39. The binomial distribution tends to the normal distribution when:

a) $np \to \lambda$ (finite) b) $n \to 0$ c) $n \to \infty$, p fixed d) $p \to 0$, $n \to \infty$, np fixed

40. The standard normal distribution has mean and variance:
a) 0 and 0 b) 1 and 0 c) 0 and 1 d) 1 and 1

41. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Central Limit Theorem b) Law of Large Numbers c) Bayes' Theorem d) Chebyshev's Inequality

42. If the two observations are 15 and −15, then their harmonic mean is:
a) 15 b) ∞ (undefined) c) 0 d) −15

43. The best fitted trend line is the one for which the sum of squares of errors is:
a) Minimum b) Maximum c) Zero d) Negative

44. The p-value in hypothesis testing represents:
a) The probability of observing the data (or more extreme), given H_0 is true b) The probability that H_0 is true c) The significance level itself d) The probability that H_1 is true

45. In stratified sampling, the population is divided into:
a) Random clusters b) Systematic intervals c) Equal-sized random groups d) Homogeneous subgroups (strata)

46. In the hypergeometric distribution, the mean nK/N represents:
a) The expected number of successes in the sample b) The population mean c) The mode d) The variance

47. The p-value in hypothesis testing represents:
a) The probability that H_1 is true b) The probability of observing the data (or more extreme), given H_0 is true c) The significance level itself d) The probability that H_0 is true

48. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) (n+1)/2 b) n/2 c) $n^2/2$ d) (n−1)/2

49. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) rc b) r + c c) (r−1)(c−1) d) r + c − 2

50. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Central Limit Theorem b) Law of Large Numbers c) Bayes' Theorem d) Chebyshev's Inequality

Section III: Computer Science and Information Technology (1×25=25)

51. A deadlock in an operating system occurs when:
a) Two or more processes wait indefinitely for resources held by each other b) None of the above c) A process uses too much CPU d) A process completes execution

52. Which data structure works on the LIFO (Last In First Out) principle?
a) Array b) Queue c) Stack d) Linked list

53. Which layer is responsible for routing data across different networks?
a) Data link layer b) Network/Internet layer c) Physical layer d) Application layer

54. Which class of language is recognized by a pushdown automaton?
a) Context-free language b) Recursively enumerable language c) Context-sensitive language d) Regular language

55. The result of $(11010)_2 - (1011)_2$ is:
a) 11100 b) 01110 c) 01111 d) 10101

56. Which of the following statements is executed by the preprocessor?
a) void main() b) printf("Hello"); c) return 0; d) #define PI 3.14

57. Which of the following best describes cloud computing?

a) A type of programming language b) A hardware component c) Storing data only on local computers d) Delivering computing services (storage, servers, software) over the internet

58. Which of the following is not a Database Management System?
a) MySQL b) Windows c) PostgreSQL d) Oracle

59. Which of the following is the most common metric for measuring algorithm efficiency?
a) Memory size b) Programming language used c) Time complexity (Big-O) d) Lines of code

60. Which diagram is used to represent the flow of data in structured software analysis?
a) Data Flow Diagram (DFD) b) Entity Relationship diagram c) Class diagram d) Use-case diagram

61. Which switching technique requires a dedicated path between sender and receiver?
a) None of the above b) Message switching c) Packet switching d) Circuit switching

62. Which of the following is an example of secondary memory?
a) RAM b) Cache c) Register d) Hard disk

63. A primary key can contain:
a) NULL values b) Neither duplicate nor NULL values c) Only NULL values d) Duplicate values

64. Which normal form removes partial dependency on a composite primary key?
a) BCNF b) 1NF c) 3NF d) 2NF

65. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 6 b) 5 c) 10 d) 4

66. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Tree b) Graph c) Stack d) Queue

67. After a rollback, a transaction is in _____ state.
a) Committed b) Partially committed c) Aborted d) Active

68. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Abstraction b) Polymorphism c) Inheritance d) Encapsulation

69. Which system development approach is best suited when requirements evolve continuously?
a) Waterfall b) None of the above c) Agile d) V-model

70. Which of the following is a valid IPv4 address?
a) 192.168.1 b) 192.168.1.1.1 c) 192.168.1.1 d) 192.168.1.256

71. The OSI model has how many layers?
a) 6 b) 5 c) 7 d) 8

72. Which system development approach is best suited when requirements evolve continuously?
a) Agile b) None of the above c) V-model d) Waterfall

73. Which normal form removes partial dependency on a composite primary key?
a) 2NF b) 1NF c) BCNF d) 3NF

74. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1 c) 192.168.1.1.1 d) 192.168.1.1

75. Round-robin scheduling is the preemptive version of:
a) Priority Scheduling b) None of the above c) Shortest Job First d) First Come First Serve (FCFS)

Section IV: Technical English (1×10=10)

76. "He is the black sheep of the family." The underlined expression has …… meaning.
a) Literal b) Figurative c) Poetic d) Contextual

77. "The thief was caught red-handed by the police." This means:

a) The thief's hands were painted red b) The police painted the thief's hand c) The thief was injured d) The thief was caught while committing the crime

78. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Adjective b) Noun c) Adverb d) Verb

79. Choose the word closest in meaning to 'meticulous':
a) Careful and precise b) Confused c) Quick d) Careless

80. 'Actions speak louder than words' means:
a) Actions are always loud b) Silence is golden c) What people do matters more than what they say d) Words are more powerful than actions

81. Neither the teacher nor the students …… present.
a) has been b) were c) was d) is

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:
a) AI is too expensive b) AI cannot analyze data c) Job displacement and data privacy d) AI is only used in healthcare

83. According to the passage, what do experts recommend?
a) Banning AI completely b) A balanced approach combining innovation and ethical safeguards c) Ignoring privacy concerns d) Using AI only in finance

84. The tone of the passage is:
a) Sarcastic b) Purely promotional c) Balanced and analytical d) Purely critical

85. The most suitable title for the passage is:
a) Healthcare Systems Today b) The Dangers of Technology c) Finance in the Modern Age d) Artificial Intelligence: Opportunities and Challenges

Section V: Logical Reasoning (1×15=15)

86. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 22 b) 24 c) 18 d) 20

87. Look at the series: 5, 9, 17, 33, ___. What number should come next?
a) 67 b) 61 c) 65 d) 63

88. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 40 b) 44 c) 42 d) 36

89. If the day before yesterday was Wednesday, what day will it be tomorrow?
a) Monday b) Saturday c) Friday d) Sunday

90. Find the odd one out:
a) Banana b) Apple c) Carrot d) Mango

91. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Father b) Grandfather c) Uncle d) Brother

92. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."
a) No conclusion b) since c) so d) Both a and b

93. Circle is to Sphere as Square is to:

a) Cube b) Cone c) Rectangle d) Cylinder

94. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Sister b) Daughter c) Mother d) Aunt

95. Find the next term: 1, 4, 9, 16, 25, ___

a) 32 b) 30 c) 36 d) 49

96. Which of the following is NOT a useful principle for making scientific progress?

a) Compare similar cases to isolate the relevant difference b) Divide the problem into manageable components c) Actively seek disconfirming evidence as well d) Look only for confirming evidence and ignore disconfirming evidence

97. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) The Earth revolves around the Sun b) Water boils at 100°C at sea level c) He scored the highest marks in class d) Could you please close the door?

98. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 18 b) 24 c) 20 d) 22

99. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 64 b) 63 c) 62 d) 61

100. Fill in the blank: MBN NBO OBP PBQ _____

a) QBR b) QBQ c) PBR d) RBQ

Answer Key — Set 20

1	2	3	4	5	6	7	8	9	10
d	a	b	c	b	a	c	a	d	a
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
d	b	a	a	d	d	b	a	b	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	b	a	c	d	c	b	d	d	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	a	a	a	d	c	d	d	c	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	b	a	a	d	a	b	a	c	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	c	b	a	c	d	d	b	c	a
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	d	b	d	b	d	c	c	c	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	a	a	d	d	b	d	c	a	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
b	c	b	c	d	d	c	c	b	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	c	a	a	c	d	d	c	b	a

PRACTICE SET 21

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The average value of f(x) = x² on the interval [0, 3] is:
a) 27 b) 1 c) 9 d) 3

2. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π/4 b) 1 c) π d) π/2

3. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 25 b) 120 c) 5 d) 3125

4. If f(x,y,z) = xy² + yz + x, the partial derivative ∂f/∂x at point (1,1,1) is:
a) 1 b) 0 c) 3 d) 2

5. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) A horizontal tangent c) An oblique tangent d) A vertical tangent

6. The Laplace transform of sinh(3t) is:
a) s/(s²−9) b) 3/(s²+9) c) 3/(s²−9) d) s/(s²+9)

7. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) II only c) III only d) I and III only

8. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3ⁿ is:
a) 3(2/3)⁵ b) 2(2/3)⁵ c) 6(2/3)⁴ d) 6(2/3)⁵

9. The general solution of the homogeneous equation (D² + 1)y = 0 is:
a) y = A cos x + B sin x b) y = Aeˣ + Be⁻ˣ c) y = A + Bx d) y = Aeⁱˣ

10. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 0, 0 b) 1, 1 c) −1, −1 d) 1, −1

11. The slope of the tangent at the origin for the curve y = sin x + x² is:
a) 0 b) -1 c) 1 d) 2

12. The Wronskian of two linearly dependent functions is:
a) Undefined b) 0 c) 1 d) −1

13. A square matrix A is called orthogonal if:
a) $A A^T = I$ b) $A^2 = I$ c) $A = A^T$ d) det(A) = 0

14. The derivative of ln(sin x) is:
a) cot x b) tan x c) −cot x d) sec x

15. Which of the following sets is countable?
a) The interval [0, 1] b) Real numbers c) Rational numbers d) Irrational numbers

16. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) It diverges b) e c) ln 2 d) 1

17. The particular integral of (D² − 1)y = eˣ is:
a) x² eˣ b) x eˣ/2 c) eˣ d) eˣ/2

18. The nullity of a 4×4 identity matrix is:
a) 4 b) 0 c) Undefined d) 1

19. Divergence of the vector field F = xî + yĵ + zk̂ is:

a) 3 b) 1 c) 2 d) 0

20. The determinant of a triangular matrix equals:

a) The sum of its diagonal elements b) Zero always c) The product of its diagonal elements d) The square of its trace

21. The radius of convergence of the series $\Sigma\, x^n/n!$ is:

a) e b) 1 c) ∞ d) 0

22. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:

a) 5/34 b) 5/√34 c) 3/√34 d) 4/√34

23. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:

a) 0 b) 1 c) e d) ∞

24. Which of the following statements is true?

a) Every bounded sequence is convergent b) Every monotonic sequence converges c) Every sequence has a limit d) Every convergent sequence is bounded

25. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:

a) Convergent b) Divergent c) Conditionally convergent d) Oscillatory

Section II: Statistics (1×25=25)

26. In time series analysis, the mathematical method most commonly used for measuring trend is:

a) Least squares method b) Free-hand curve method c) Semi-average method d) Moving average method

27. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:

a) Kurtosis of X b) Mean of X c) Variance of X d) Skewness of X

28. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:

a) Zero b) Unity c) Positive d) Negative

29. Which distribution is used for testing the equality of two population variances?

a) Chi-square distribution b) Normal distribution c) t-distribution d) F-distribution

30. The statistical test generally used to test association between two independent categorical variables is:

a) t-test b) Chi-square test c) F-test d) Z-test

31. In simple random sampling without replacement from a finite population, each unit has:

a) A probability depending on order drawn b) An equal probability of selection c) An unequal probability of selection d) Zero probability of selection

32. If the correlation coefficient r = 0 between X and Y, it implies:

a) A negative relationship between X and Y b) A perfect relationship between X and Y c) No relationship at all between X and Y d) No linear relationship between X and Y

33. The variance of a constant c is:

a) 0 b) c c) c^2 d) Undefined

34. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:

a) $Z = (a-\mu)/\sigma^2$ b) $Z = (a-\mu)\sigma$ c) $Z = (a-\mu)/\sigma$ d) $Z = (a-\mu)/\sqrt{n}$

35. The geometric mean of 2, 4, and 8 is:

a) 4 b) 8 c) 4.67 d) 5

36. In a binomial distribution, if the probability of success π = 0.5, then Pr(X=x) is given by:

a) ${}_nC_n(0.5)^x$ b) ${}_nC_x(0.5)^x$ c) ${}_nC_x(0.5)^{(n-x)}$ d) ${}_nC_x(0.5)^n$

37. In usual notation, if E(X) = 3 and $E(X^2) = 13$, then the standard deviation of X is:

a) 13 b) 4 c) 2 d) 9

38. The coefficient of determination R^2 measures:

a) None of the above b) The proportion of variation in the dependent variable explained by the independent variable c) The total unexplained variation in the model d) The proportion of variation in the independent variable explained by the dependent variable

39. The standard deviation of a distribution is always:

a) Zero b) Undefined c) Negative d) Non-negative

40. The binomial distribution tends to the normal distribution when:

a) $np \to \lambda$ (finite) b) $n \to \infty$, p fixed c) $p \to 0$, $n \to \infty$, np fixed d) $n \to 0$

41. The best fitted trend line is the one for which the sum of squares of errors is:

a) Minimum b) Zero c) Maximum d) Negative

42. The sum of squares of deviations is minimum when measured from the:

a) Geometric mean b) Mode c) Mean d) Median

43. In hypothesis testing, a Type II error occurs when we:

a) Reject H_0 when H_0 is true b) Reject H_1 when H_1 is true c) None of the above d) Accept H_0 when H_0 is false

44. If the two observations are 15 and −15, then their harmonic mean is:

a) 0 b) 15 c) −15 d) ∞ (undefined)

45. The probability density function of a normal random variate X with mean 10 and variance 4 is:

a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$ b) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$ d) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$

46. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:

a) 6 b) 4 c) 3 d) 5

47. A Type I error is also known as:

a) Beta error b) Sampling error c) Standard error d) Alpha error (false positive)

48. The chi-square test statistic can never be:

a) A decimal value b) Zero c) Negative d) Positive

49. For a Poisson distribution, which of the following is true?

a) Mean < Variance b) Mean = Variance c) Mean > Variance d) None of the above

50. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:

a) −0.2 b) 0.2 c) 0.1 d) 0.3

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following is an example of supervised learning?

a) Principal Component Analysis b) K-means clustering c) Linear regression d) Association rule mining

52. Which diagram is used to represent the flow of data in structured software analysis?

a) Data Flow Diagram (DFD) b) Class diagram c) Entity Relationship diagram d) Use-case diagram

53. Which protocol is used to send email?

a) SNMP b) HTTP c) SMTP d) FTP

54. A firewall is primarily used to:

a) Store data backups b) Control and filter network traffic for security c) Speed up an internet connection d) Compress files

55. Which layer is responsible for routing data across different networks?

a) Data link layer b) Physical layer c) Network/Internet layer d) Application layer

56. How many times will the loop for(i=10; i>0; i-=2) execute?

a) 4 b) 10 c) 5 d) 6

57. Which of the following is a compiled language?
a) JavaScript b) C c) PHP d) Python

58. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Abstraction b) Polymorphism c) Inheritance d) Encapsulation

59. The ability of objects to take on multiple forms is called:
a) Encapsulation b) Polymorphism c) Inheritance d) Abstraction

60. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Fluorescence c) Refresh rate d) Persistence

61. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) BCNF b) 4NF c) 1NF d) 2NF

62. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) SELECT, FROM, WHERE d) WHERE, SELECT, FROM

63. Which class of language is recognized by a pushdown automaton?
a) Regular language b) Recursively enumerable language c) Context-free language d) Context-sensitive language

64. A primary key can contain:
a) NULL values b) Duplicate values c) Neither duplicate nor NULL values d) Only NULL values

65. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Selection sort c) Bubble sort d) Quick sort

66. Which of the following statements is true regarding relational database keys?
a) A relation can have only one foreign key b) A relation can have only one primary key c) A relation can have multiple candidate keys d) A relation can have only one candidate key

67. HTTP stands for:
a) Host Transfer Text Protocol b) HyperText Transmission Process c) HyperText Transfer Protocol d) High Transfer Text Protocol

68. Which of the following is not a Database Management System?
a) MySQL b) Oracle c) PostgreSQL d) Windows

69. The time complexity of binary search on a sorted array of n elements is:
a) O(n log n) b) O(n) c) O(log n) d) O(1)

70. In machine learning, overfitting refers to a model that:
a) Performs well on training data but poorly on new/unseen data b) Performs equally well on all datasets c) Cannot be trained at all d) Performs poorly on training data

71. Which of the following statements is executed by the preprocessor?
a) void main() b) #define PI 3.14 c) printf("Hello"); d) return 0;

72. Which data structure works on the LIFO (Last In First Out) principle?
a) Array b) Stack c) Queue d) Linked list

73. Which of the following best describes cloud computing?
a) Delivering computing services (storage, servers, software) over the internet b) Storing data only on local computers c) A hardware component d) A type of programming language

74. Which switching technique requires a dedicated path between sender and receiver?
a) Circuit switching b) Message switching c) None of the above d) Packet switching

75. Which of the following is an example of secondary memory?
a) Cache b) Register c) RAM d) Hard disk

Section IV: Technical English (1×10=10)

76. Neither the teacher nor the students …… present.
a) were b) has been c) was d) is

77. He asked me ……
a) that where do I live b) where I lived c) where I will live d) that where I lived

78. The idiom 'to hit the nail on the head' means:
a) To say or do something exactly right b) To work with tools c) To hurt someone d) To make a mistake

79. Choose the correctly punctuated sentence:
a) It's a nice day b) Its a nice day c) Its' a nice day d) It is'nt a nice day

80. The phrase 'in the nick of time' means:
a) At the beginning b) In the near future c) At the very last possible moment d) Too late

81. "The thief was caught red-handed by the police." This means:
a) The police painted the thief's hand b) The thief was injured c) The thief was caught while committing the crime d) The thief's hands were painted red

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:
a) Only entertainment b) Agriculture c) Education, healthcare, and employment d) None of the above

83. Which of the following is mentioned as a challenge of urbanization?
a) Traffic congestion b) Abundant farmland c) Excess housing d) Low population

84. What does the passage suggest is essential for livable cities?
a) Sustainable urban planning b) Removing green spaces c) Reducing population to zero d) Banning public transport

85. The passage is primarily about:
a) Rural life b) Global warming c) The opportunities and challenges of urbanization d) The history of cities

Section V: Logical Reasoning (1×15=15)

86. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 40 b) 36 c) 42 d) 44

87. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?
a) Mother b) Daughter c) Sister d) Aunt

88. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?
a) Tree Stole a Painting b) Painting Found Near a Tree c) Tree Found Stolen Painting d) Painting Found Stolen by a Tree

89. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 62 b) 63 c) 64 d) 61

90. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Partially follows b) Follows c) Cannot be determined d) Does not follow

91. Choose the word that does NOT belong with the others:
a) Cube b) Circle c) Square d) Triangle

92. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Both I and II follow b) Neither I nor II follows c) Only conclusion I follows d) Only conclusion II follows

93. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Grandfather b) Father c) Brother d) Uncle

94. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) II only b) II and III only c) I, II, and III d) None of the statements is true

95. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the son of c b) a is the uncle of c c) a is the father of c d) a is the brother of c

96. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 22 b) 24 c) 20 d) 18

97. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) bota b) winbo c) ligowin d) bowin

98. All cats are animals. No animal is a plant. Therefore:
a) Some cats are plants b) All plants are animals c) No cat is a plant d) No conclusion can be drawn

99. Find the missing number: 2, 5, 10, 17, 26, ___
a) 38 b) 35 c) 36 d) 37

100. If the day before yesterday was Wednesday, what day will it be tomorrow?
a) Friday b) Monday c) Saturday d) Sunday

Answer Key — Set 21

1	2	3	4	5	6	7	8	9	10
d	a	b	d	d	c	d	d	a	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	b	a	a	c	c	b	b	a	c
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	b	c	d	b	a	c	c	d	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	d	a	c	a	d	c	b	d	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	c	d	d	d	d	d	c	b	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	a	c	b	c	c	b	c	b	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
a	a	c	c	d	c	c	d	c	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
b	b	a	a	d	a	b	a	a	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**

c	c	a	a	c	c	c	b	b	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	c	b	b	b	c	d	c	d	c

PRACTICE SET 22

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Which of the following is an even function?
a) x^3 b) sin x c) cos x d) x

2. The value of $\int_0^{\pi} \sin x\, dx$ is:
a) 0 b) 1 c) 2 d) π

3. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 3, 3 b) 4, 2 c) 2, −2 d) 6, 0

4. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 4e^(2x) b) e^(2x) c) 0 d) −4e^(2x)

5. Let f(x) = x^2 for x ≤ 0 and f(x) = x for x > 0. Then f is:
a) Differentiable at x = 0 b) Discontinuous at x = 0 c) Continuous but not differentiable at x = 0 d) An even function

6. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,−1), v=(1,1) b) u=(1,1), v=(1,1) c) u=(1,1), v=(3,−1) d) u=(2,1), v=(1,2)

7. The general solution of dy/dx = y/x is:
a) y = C/x b) $y = Cx^2$ c) $y = Ce^x$ d) y = Cx

8. A monotonic decreasing bounded sequence converges to its:
a) Upper bound b) Maximum c) Supremum d) Infimum

9. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Undefined c) Unity d) Zero

10. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cosh3x + B sinh3x b) A cos3x + B sin3x c) $A e^{3x} + B e^{-3x}$ d) $A e^{9x} + B e^{-9x}$

11. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) Undefined b) ∞ c) 1 d) 0

12. The value of $\int e^x \cos x\, dx$ is:
a) $e^x \cos x + C$ b) $(e^x/2)(\sin x - \cos x) + C$ c) $(e^x/2)(\sin x + \cos x) + C$ d) $e^x \sin x + C$

13. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Infimum c) Supremum d) Minimum

14. A continuous function on a closed and bounded interval [a, b] is always:
a) Differentiable on [a, b] b) Unbounded on [a, b] c) Monotonic on [a, b] d) Uniformly continuous on [a, b]

15. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 3 b) 0 c) 1 d) 2

16. $\int_0^1 1/(1+x^2)\, dx$ equals:
a) π b) π/2 c) π/4 d) 1

17. The value of $\int e^x \cos x\, dx$ is:
a) $(e^x/2)(\sin x + \cos x) + C$ b) $e^x \sin x + C$ c) $(e^x/2)(\sin x - \cos x) + C$ d) $e^x \cos x + C$

18. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 6, 0 c) 3, 3 d) 4, 2

19. Which of the following is an even function?

a) x b) x^3 c) cos x d) sin x

20. The sequence $b_n = \Sigma_{k=1}^{n} 1/(n+k)$ converges to:
a) e b) ln 2 c) It diverges d) 1

21. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A \cos x + B \sin x$ b) $y = A + Bx$ c) $y = Ae^x + Be^{-x}$ d) $y = Ae^{ix}$

22. A continuous function on a closed and bounded interval [a, b] is always:
a) Unbounded on [a, b] b) Monotonic on [a, b] c) Differentiable on [a, b] d) Uniformly continuous on [a, b]

23. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 0 b) 3 c) 2 d) 1

24. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 2 b) 1 c) 0 d) 3

25. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 27 b) 3 c) 1 d) 9

Section II: Statistics (1×25=25)

26. The standard normal distribution has mean and variance:
a) 1 and 0 b) 1 and 1 c) 0 and 0 d) 0 and 1

27. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ and λ b) λ^2 and λ c) λ and λ^2 d) $1/\lambda$ and $1/\lambda^2$

28. The appropriate statistical test for comparing means across more than two independent groups is:
a) Chi-square test b) t-test c) Z-test d) F-test (ANOVA)

29. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 1/2 b) 1/8 c) 3/8 d) 5/8

30. In stratified sampling, the population is divided into:
a) Homogeneous subgroups (strata) b) Random clusters c) Systematic intervals d) Equal-sized random groups

31. If two events A and B are independent, then $P(A \cap B)$ equals:
a) P(A)/P(B) b) P(A) − P(B) c) P(A) + P(B) d) P(A)·P(B)

32. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Median b) Harmonic mean c) Geometric mean d) Arithmetic mean

33. The correlation coefficient r always lies between:
a) $-\infty$ and ∞ b) −1 and 1 c) 0 and ∞ d) 0 and 1

34. The probability of an impossible event is:
a) 0 b) 0.5 c) 1 d) Undefined

35. Which measure of central tendency is most affected by extreme values (outliers)?
a) None of the above b) Mean c) Mode d) Median

36. The coefficient of variation is computed using the formula:
a) (s.d./mean) × 100 b) (mean/s.d.) × 100 c) 100/(mean × s.d.) d) (mean × s.d.)/100

37. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 60 b) 10 c) 15 d) 125

38. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) Wider c) Cannot be determined d) The same width

39. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:

a) One-sided lower-tailed test b) None of the above c) One-sided upper-tailed test d) Two-tailed test

40. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 16 b) 15.5 c) 23 d) 15

41. The coefficient of determination R^2 measures:
a) The proportion of variation in the dependent variable explained by the independent variable b) The proportion of variation in the independent variable explained by the dependent variable c) The total unexplained variation in the model d) None of the above

42. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 4 c) 9 d) 2

43. The probability of an impossible event is:
a) Undefined b) 0.5 c) 1 d) 0

44. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.3 b) 0.2 c) 0.1 d) −0.2

45. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sigma^2$ b) $Z = (a-\mu)/\sqrt{n}$ c) $Z = (a-\mu)/\sigma$ d) $Z = (a-\mu)\sigma$

46. In simple random sampling without replacement from a finite population, each unit has:
a) Zero probability of selection b) An equal probability of selection c) A probability depending on order drawn d) An unequal probability of selection

47. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 5 b) 3 c) 4 d) 6

48. The standard deviation of a distribution is always:
a) Negative b) Non-negative c) Zero d) Undefined

49. The coefficient of variation is computed using the formula:
a) (s.d./mean) × 100 b) (mean × s.d.)/100 c) 100/(mean × s.d.) d) (mean/s.d.) × 100

50. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c b) r + c − 2 c) (r−1)(c−1) d) rc

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following information is required to normalize a relation into 3NF?
a) Join dependency b) None of the above c) Functional dependency d) Multivalued dependency

52. Which of the following is used to uniquely identify a device on a network?
a) HTML tag b) Domain name c) URL d) MAC address

53. The result of $(11010)_2 - (1011)_2$ is:
a) 01111 b) 11100 c) 01110 d) 10101

54. Which of the following is an entry-controlled loop?
a) None of the above b) Both while and do-while c) while d) do-while

55. IP in the context of networking stands for:
a) Interface Path b) Internet Protocol c) Internal Process d) Information Packet

56. After a rollback, a transaction is in _____ state.
a) Committed b) Aborted c) Partially committed d) Active

57. Which SDLC phase focuses on gathering and documenting user requirements?
a) Testing b) Design c) Maintenance d) Requirement Analysis

58. Which software is most commonly used for spreadsheet-based data analysis?

a) SPSS b) MS Paint c) MS Excel d) Photoshop

59. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Tree c) Stack d) Queue

60. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.128 b) 255.255.255.224 c) 255.255.255.0 d) 255.255.255.192

61. Which of the following is a NoSQL database?
a) Oracle b) MySQL c) MongoDB d) PostgreSQL

62. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) TRUNCATE c) DELETE d) DROP

63. A deadlock in an operating system occurs when:
a) Two or more processes wait indefinitely for resources held by each other b) A process uses too much CPU c) A process completes execution d) None of the above

64. Which of the following is the most common metric for measuring algorithm efficiency?
a) Lines of code b) Programming language used c) Memory size d) Time complexity (Big-O)

65. Recursion in programming is best described as:
a) A data structure b) A function calling itself to solve smaller instances of a problem c) A loop with no exit condition d) A function that never returns

66. After a rollback, a transaction is in _____ state.
a) Aborted b) Partially committed c) Committed d) Active

67. Which of the following is an example of supervised learning?
a) Association rule mining b) Linear regression c) Principal Component Analysis d) K-means clustering

68. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Tree c) Queue d) Stack

69. Which SDLC phase focuses on gathering and documenting user requirements?
a) Maintenance b) Design c) Requirement Analysis d) Testing

70. Which switching technique requires a dedicated path between sender and receiver?
a) Message switching b) Packet switching c) Circuit switching d) None of the above

71. Which system development approach is best suited when requirements evolve continuously?
a) Waterfall b) V-model c) Agile d) None of the above

72. Which of the following statements is executed by the preprocessor?
a) #define PI 3.14 b) void main() c) return 0; d) printf("Hello");

73. The time complexity of binary search on a sorted array of n elements is:
a) O(log n) b) O(n log n) c) O(n) d) O(1)

74. Which of the following statements is true regarding relational database keys?
a) A relation can have multiple candidate keys b) A relation can have only one candidate key c) A relation can have only one foreign key d) A relation can have only one primary key

75. The ability of objects to take on multiple forms is called:
a) Inheritance b) Encapsulation c) Polymorphism d) Abstraction

Section IV: Technical English (1×10=10)

76. Which of the following is a compound sentence?
a) She sings well. b) Singing well is her passion. c) Because she practices, she sings well. d) She sings well, and she dances gracefully.

77. Choose the word closest in meaning to 'meticulous':
a) Careful and precise b) Careless c) Confused d) Quick

78. "He is the black sheep of the family." The underlined expression has …… meaning.
a) Contextual b) Figurative c) Poetic d) Literal

79. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Noun b) Adverb c) Adjective d) Verb

80. Choose the correct form: 'One of the students _____ absent today.'
a) were b) are c) have been d) is

81. The antonym of 'diligent' is:
a) Lazy b) Careful c) Punctual d) Hardworking

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:
a) Renewable energy is gaining importance due to environmental benefits b) Fossil fuels are better than renewables
c) Governments dislike renewable energy d) Wind energy is the only alternative

83. The mode of approach in the passage is:
a) Narrative b) Poetic c) Argumentative d) Descriptive

84. According to the passage, one benefit of renewable energy is:
a) Limited availability b) Low greenhouse gas emissions c) High cost d) Requiring fossil fuel input

85. The most appropriate title for the passage is:
a) Renewable Energy: A Sustainable Future b) The Decline of Fossil Fuels c) Solar Power Only d) Climate Change Effects

Section V: Logical Reasoning (1×15=15)

86. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Both I and II follow b) Neither I nor II follows c) Only conclusion II follows d) Only conclusion I follows

87. Fill in the blank: MBN NBO OBP PBQ _____
a) PBR b) QBR c) RBQ d) QBQ

88. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) All Lazzies are Bloops b) All Bloops are Lazzies c) No Bloops are Lazzies d) Some Lazzies are not Razzies

89. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) Water boils at 100°C at sea level b) The Earth revolves around the Sun c) He scored the highest marks in class
d) Could you please close the door?

90. Look at the series: 5, 9, 17, 33, ___. What number should come next?
a) 63 b) 65 c) 61 d) 67

91. Circle is to Sphere as Square is to:
a) Cylinder b) Cone c) Cube d) Rectangle

92. Find the next term: 1, 4, 9, 16, 25, ___
a) 49 b) 32 c) 30 d) 36

93. Which of the following is NOT a useful principle for making scientific progress?

a) Actively seek disconfirming evidence as well b) Look only for confirming evidence and ignore disconfirming evidence c) Divide the problem into manageable components d) Compare similar cases to isolate the relevant difference

94. Find the odd one out:

a) Apple b) Mango c) Banana d) Carrot

95. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?

a) 18 b) 20 c) 24 d) 22

96. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) so b) No conclusion c) since d) Both a and b

97. Which number should replace the question mark: 7, 14, 28, 56, ?

a) 112 b) 84 c) 120 d) 98

98. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UACMF b) UBCMF c) UBCLF d) TBCMF

99. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.

Conclusion II: All erasers are pencils.

Which one is true?

a) Both I and II follow b) Only conclusion I follows c) Neither I nor II follows d) Only conclusion II follows

100. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EPG b) DPH c) EOH d) EPH

Answer Key — Set 22

1	2	3	4	5	6	7	8	9	10
c	c	b	c	c	c	d	d	d	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	c	b	d	d	c	a	d	c	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	d	c	a	b	d	a	d	c	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	c	b	a	b	a	d	b	c	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	d	d	b	c	b	a	b	a	c
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	d	a	c	b	b	d	c	d	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	d	a	d	b	a	b	c	c	c
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	a	a	a	c	d	a	b	b	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	a	d	b	a	d	b	b	d	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
c	d	b	d	b	a	a	b	b	d

PRACTICE SET 23

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The locus of the equation xz + yz = 0 is:
a) A straight line b) A single plane c) A pair of parallel planes d) A pair of perpendicular planes

2. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) A vertical tangent c) A horizontal tangent d) An oblique tangent

3. The nullity of a 4×4 identity matrix is:
a) Undefined b) 0 c) 4 d) 1

4. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 1 b) 0 c) -1 d) 2

5. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, −1 b) −1, −1 c) 0, 0 d) 1, 1

6. The derivative of ln(sin x) is:
a) −cot x b) sec x c) tan x d) cot x

7. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) 1 b) ∞ c) 0 d) e

8. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $x\,e^x/2$ b) $x^2\,e^x$ c) e^x d) $e^x/2$

9. Let f(x) = x² for x ≤ 0 and f(x) = x for x > 0. Then f is:
a) Differentiable at x = 0 b) Continuous but not differentiable at x = 0 c) An even function d) Discontinuous at x = 0

10. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Singular b) Orthogonal c) Symmetric d) Invertible

11. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(1,1) b) u=(1,−1), v=(1,1) c) u=(1,1), v=(3,−1) d) u=(2,1), v=(1,2)

12. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Infimum b) Minimum c) Maximum d) Supremum

13. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) ∞ b) 0 c) 1 d) Undefined

14. Which of the following statements is true?
a) Every monotonic sequence converges b) Every sequence has a limit c) Every bounded sequence is convergent d) Every convergent sequence is bounded

15. The general solution of dy/dx = y/x is:
a) $y = Cx^2$ b) y = C/x c) $y = Ce^x$ d) y = Cx

16. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 0 b) 3 c) 2 d) 1

17. A monotonic decreasing bounded sequence converges to its:
a) Supremum b) Upper bound c) Infimum d) Maximum

18. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) −4e^(2x) b) 4e^(2x) c) 0 d) e^(2x)

19. The number of one-one (injective) functions from a set of 5 elements to itself is:

a) 120 b) 25 c) 5 d) 3125

20. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 5/34 b) 5/√34 c) 3/√34 d) 4/√34

21. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A e^{3x} + B e^{-3x}$ b) $A e^{9x} + B e^{-9x}$ c) A cosh3x + B sinh3x d) A cos3x + B sin3x

22. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 6 b) 3/4 c) 9 d) 4/3

23. Curl of the gradient of a scalar function is always:
a) Unity b) Undefined c) Equal to its divergence d) Zero

24. The value of $\int_0^{\pi} \sin x \, dx$ is:
a) π b) 1 c) 2 d) 0

25. The radius of convergence of the series $\Sigma x^n/n!$ is:
a) 0 b) ∞ c) 1 d) e

Section II: Statistics (1×25=25)

26. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) Chi-square test c) Z-test d) t-test

27. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Harmonic mean b) Geometric mean c) Median d) Arithmetic mean

28. The standard normal distribution has mean and variance:
a) 1 and 0 b) 0 and 0 c) 0 and 1 d) 1 and 1

29. In hypothesis testing, a Type II error occurs when we:
a) None of the above b) Accept H_0 when H_0 is false c) Reject H_0 when H_0 is true d) Reject H_1 when H_1 is true

30. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi}) \exp\{-(x-10)^2/2\}$ b) $1/(2\sqrt{2\pi}) \exp\{-(x-10)^2/8\}$ c) $1/\sqrt{2\pi} \exp\{-(x-10)^2/8\}$ d) $1/\sqrt{2\pi} \exp\{-(x-10)^2/2\}$

31. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15.5 b) 15 c) 23 d) 16

32. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ and λ^2 b) λ and λ c) λ^2 and λ d) 1/λ and $1/\lambda^2$

33. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Least squares method b) Free-hand curve method c) Semi-average method d) Moving average method

34. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Bayes' Theorem b) Chebyshev's Inequality c) Law of Large Numbers d) Central Limit Theorem

35. In the hypergeometric distribution, the mean nK/N represents:
a) The expected number of successes in the sample b) The mode c) The variance d) The population mean

36. The statistical test generally used to test association between two independent categorical variables is:
a) t-test b) F-test c) Z-test d) Chi-square test

37. The binomial distribution tends to the normal distribution when:
a) $n \to \infty$, p fixed b) $np \to \lambda$ (finite) c) $n \to 0$ d) $p \to 0$, $n \to \infty$, np fixed

38. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided lower-tailed test b) Two-tailed test c) One-sided upper-tailed test d) None of the above

39. The variance of a constant c is:
a) c^2 b) c c) 0 d) Undefined

40. A Type I error is also known as:
a) Beta error b) Standard error c) Alpha error (false positive) d) Sampling error

41. The sum of squares of deviations is minimum when measured from the:
a) Mean b) Median c) Mode d) Geometric mean

42. In stratified sampling, the population is divided into:
a) Systematic intervals b) Random clusters c) Equal-sized random groups d) Homogeneous subgroups (strata)

43. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) - P(B)$ b) $P(A) \cdot P(B)$ c) $P(A) + P(B)$ d) $P(A)/P(B)$

44. The chi-square test statistic can never be:
a) Negative b) A decimal value c) Zero d) Positive

45. Which distribution is used for testing the equality of two population variances?
a) F-distribution b) Normal distribution c) t-distribution d) Chi-square distribution

46. For a Poisson distribution, which of the following is true?
a) Mean = Variance b) Mean > Variance c) None of the above d) Mean < Variance

47. If the two observations are 15 and −15, then their harmonic mean is:
a) 0 b) ∞ (undefined) c) 15 d) −15

48. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) $(n+1)/2$ b) $n^2/2$ c) $n/2$ d) $(n-1)/2$

49. The p-value in hypothesis testing represents:
a) The probability that H_1 is true b) The significance level itself c) The probability that H_0 is true d) The probability of observing the data (or more extreme), given H_0 is true

50. The geometric mean of 2, 4, and 8 is:
a) 8 b) 4 c) 5 d) 4.67

Section III: Computer Science and Information Technology (1×25=25)

51. The OSI model has how many layers?
a) 8 b) 7 c) 5 d) 6

52. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1 c) 192.168.1.1.1 d) 192.168.1.1

53. A deadlock in an operating system occurs when:
a) Two or more processes wait indefinitely for resources held by each other b) A process completes execution c) None of the above d) A process uses too much CPU

54. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 4 b) 5 c) 6 d) 10

55. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Persistence b) Phosphorescence c) Refresh rate d) Fluorescence

56. Round-robin scheduling is the preemptive version of:
a) Shortest Job First b) Priority Scheduling c) First Come First Serve (FCFS) d) None of the above

57. Which diagram is used to represent the flow of data in structured software analysis?
a) Class diagram b) Entity Relationship diagram c) Use-case diagram d) Data Flow Diagram (DFD)

58. Which class of language is recognized by a pushdown automaton?

a) Context-free language b) Regular language c) Recursively enumerable language d) Context-sensitive language

59. The result of $(11010)_2 - (1011)_2$ is:
a) 01110 b) 11100 c) 01111 d) 10101

60. Recursion in programming is best described as:
a) A function that never returns b) A function calling itself to solve smaller instances of a problem c) A loop with no exit condition d) A data structure

61. Which of the following best describes cloud computing?
a) Storing data only on local computers b) Delivering computing services (storage, servers, software) over the internet c) A hardware component d) A type of programming language

62. HTTP stands for:
a) HyperText Transmission Process b) High Transfer Text Protocol c) Host Transfer Text Protocol d) HyperText Transfer Protocol

63. Which sorting algorithm has the best average-case time complexity among the following?
a) Insertion sort b) Quick sort c) Bubble sort d) Selection sort

64. A primary key can contain:
a) Only NULL values b) Neither duplicate nor NULL values c) NULL values d) Duplicate values

65. Which software is most commonly used for spreadsheet-based data analysis?
a) Photoshop b) MS Paint c) SPSS d) MS Excel

66. Which of the following is a compiled language?
a) C b) Python c) PHP d) JavaScript

67. In machine learning, overfitting refers to a model that:
a) Cannot be trained at all b) Performs well on training data but poorly on new/unseen data c) Performs equally well on all datasets d) Performs poorly on training data

68. Which protocol is used to send email?
a) SMTP b) SNMP c) FTP d) HTTP

69. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) SELECT, FROM, WHERE d) WHERE, SELECT, FROM

70. Which of the following is the most common metric for measuring algorithm efficiency?
a) Time complexity (Big-O) b) Lines of code c) Memory size d) Programming language used

71. Which of the following is not a Database Management System?
a) MySQL b) Oracle c) PostgreSQL d) Windows

72. A firewall is primarily used to:
a) Speed up an internet connection b) Store data backups c) Compress files d) Control and filter network traffic for security

73. Which of the following is an entry-controlled loop?
a) do-while b) Both while and do-while c) while d) None of the above

74. Which of the following information is required to normalize a relation into 3NF?
a) Multivalued dependency b) Join dependency c) None of the above d) Functional dependency

75. IP in the context of networking stands for:
a) Internal Process b) Internet Protocol c) Interface Path d) Information Packet

Section IV: Technical English (1×10=10)

76. Choose the correct passive voice of 'She is writing a letter.'

a) A letter is written by her b) A letter is being written by her c) A letter has been written by her d) A letter was being written by her

77. The synonym of 'abundant' is:

a) Plentiful b) Limited c) Scarce d) Rare

78. 'Actions speak louder than words' means:

a) Silence is golden b) Actions are always loud c) Words are more powerful than actions d) What people do matters more than what they say

79. Choose the correctly spelled word:

a) Recieve b) Receiv c) Receive d) Receve

80. 'He is used to _____ early.'

a) woke b) waken c) wake d) waking

81. Identify the correctly punctuated sentence:

a) Although it was raining we, went for a walk. b) Although it was, raining we went for a walk. c) Although it was raining, we went for a walk. d) Although, it was raining we went for a walk.

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:

a) Job displacement and data privacy b) AI is only used in healthcare c) AI is too expensive d) AI cannot analyze data

83. According to the passage, what do experts recommend?

a) Ignoring privacy concerns b) Banning AI completely c) Using AI only in finance d) A balanced approach combining innovation and ethical safeguards

84. The tone of the passage is:

a) Purely critical b) Balanced and analytical c) Sarcastic d) Purely promotional

85. The most suitable title for the passage is:

a) The Dangers of Technology b) Finance in the Modern Age c) Healthcare Systems Today d) Artificial Intelligence: Opportunities and Challenges

Section V: Logical Reasoning (1×15=15)

86. Find the next term: 1, 4, 9, 16, 25, ___

a) 30 b) 36 c) 49 d) 32

87. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Tree Found Stolen Painting b) Painting Found Near a Tree c) Tree Stole a Painting d) Painting Found Stolen by a Tree

88. Choose the word that does NOT belong with the others:

a) Circle b) Cube c) Triangle d) Square

89. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 40 b) 42 c) 36 d) 44

90. Which sentence below is probably not being used to make a claim (that is, a statement)?

a) Could you please close the door? b) Water boils at 100°C at sea level c) He scored the highest marks in class d) The Earth revolves around the Sun

91. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Sister b) Aunt c) Daughter d) Mother

92. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) Both a and b b) No conclusion c) so d) since

93. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) bowin b) bota c) ligowin d) winbo

94. Statement: Regular exercise improves cardiovascular health and mental well-being.

Conclusion I: People who exercise regularly tend to be healthier.

Conclusion II: People should exercise every day for one hour.

Which one is true?

a) Both I and II follow b) Neither I nor II follows c) Only conclusion I follows d) Only conclusion II follows

95. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.

Conclusion II: The economic slowdown affected the company.

Which one is true?

a) Only conclusion I follows b) Both I and II follow c) Neither I nor II follows d) Only conclusion II follows

96. Statement: Some pens are pencils. All pencils are erasers.

Conclusion I: Some pens are erasers.

Conclusion II: All erasers are pencils.

Which one is true?

a) Both I and II follow b) Neither I nor II follows c) Only conclusion II follows d) Only conclusion I follows

97. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 64 b) 62 c) 61 d) 63

98. Read the following carefully:

I. P+Q means P is the son of Q

II. P−Q means P is the wife of Q

III. P×Q means P is the brother of Q

IV. P÷Q means P is the mother of Q

V. P=Q means P is the sister of Q

What does a×b÷c mean?

a) a is the father of c b) a is the brother of c c) a is the son of c d) a is the uncle of c

99. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) All Lazzies are Bloops b) No Bloops are Lazzies c) All Bloops are Lazzies d) Some Lazzies are not Razzies

100. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 20 b) 24 c) 22 d) 18

Answer Key — Set 23

1	2	3	4	5	6	7	8	9	10
d	b	b	a	a	d	d	a	b	a
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	a	c	d	d	b	c	c	a	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	b	d	c	b	a	b	c	b	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	b	a	d	a	d	a	c	c	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	d	b	a	a	a	b	a	d	b

51	52	53	54	55	56	57	58	59	60
b	d	a	b	d	c	d	a	c	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b	d	b	b	d	a	b	a	a	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	d	c	d	b	b	a	d	c	d
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
c	a	d	b	d	b	b	b	b	a
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	c	a	c	a	d	d	d	c	a

PRACTICE SET 24

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The Wronskian of two linearly dependent functions is:
a) Undefined b) 0 c) −1 d) 1

2. A square matrix A is called orthogonal if:
a) $\det(A) = 0$ b) $A\,A^T = I$ c) $A = A^T$ d) $A^2 = I$

3. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) Onto but not one-one b) Neither one-one nor onto c) One-one and onto d) One-one but not onto

4. The Laplace transform of sinh(3t) is:
a) $3/(s^2-9)$ b) $s/(s^2+9)$ c) $s/(s^2-9)$ d) $3/(s^2+9)$

5. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) II only b) III only c) I and III only d) I only

6. Which of the following sets is countable?
a) Irrational numbers b) Rational numbers c) Real numbers d) The interval [0, 1]

7. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3ⁿ is:
a) $2(2/3)^5$ b) $6(2/3)^4$ c) $3(2/3)^5$ d) $6(2/3)^5$

8. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Divergent b) Oscillatory c) Conditionally convergent d) Convergent

9. The determinant of a triangular matrix equals:
a) Zero always b) The product of its diagonal elements c) The sum of its diagonal elements d) The square of its trace

10. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x^2 b) $1/x$ c) x d) $\ln x$

11. A monotonic decreasing bounded sequence converges to its:
a) Maximum b) Infimum c) Supremum d) Upper bound

12. A square matrix A is called orthogonal if:
a) $A\,A^T = I$ b) $A^2 = I$ c) $A = A^T$ d) $\det(A) = 0$

13. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) $3/\sqrt{34}$ b) $5/\sqrt{34}$ c) $5/34$ d) $4/\sqrt{34}$

14. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, −1 b) 0, 0 c) 1, 1 d) −1, −1

15. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 3, 3 b) 6, 0 c) 4, 2 d) 2, −2

16. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 1 b) 9 c) 27 d) 3

17. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $x^2 e^x$ b) $e^x/2$ c) $x\, e^x/2$ d) e^x

18. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:
a) Divergent b) Oscillatory c) Convergent d) Conditionally convergent

19. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) ∞ b) 1 c) e d) 0

20. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) II only c) I and III only d) III only

21. The Laplace transform of sinh(3t) is:
a) $3/(s^2-9)$ b) $s/(s^2+9)$ c) $3/(s^2+9)$ d) $s/(s^2-9)$

22. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A\,e^{9x} + B\,e^{-9x}$ b) $A\cos 3x + B\sin 3x$ c) $A\cosh 3x + B\sinh 3x$ d) $A\,e^{3x} + B\,e^{-3x}$

23. A continuous function on a closed and bounded interval [a, b] is always:
a) Monotonic on [a, b] b) Uniformly continuous on [a, b] c) Unbounded on [a, b] d) Differentiable on [a, b]

24. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) ln x b) x c) x^2 d) 1/x

25. The Wronskian of two linearly dependent functions is:
a) −1 b) 0 c) 1 d) Undefined

Section II: Statistics (1×25=25)

26. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Skewness of X b) Kurtosis of X c) Variance of X d) Mean of X

27. The correlation coefficient r always lies between:
a) −1 and 1 b) −∞ and ∞ c) 0 and ∞ d) 0 and 1

28. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 5/8 b) 3/8 c) 1/8 d) 1/2

29. If the correlation coefficient r = 0 between X and Y, it implies:
a) No relationship at all between X and Y b) No linear relationship between X and Y c) A negative relationship between X and Y d) A perfect relationship between X and Y

30. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Zero b) Positive c) Unity d) Negative

31. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 15 b) 60 c) 10 d) 125

32. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Cannot be determined b) The same width c) Narrower d) Wider

33. In a binomial distribution, if the probability of success π = 0.5, then Pr(X=x) is given by:
a) ${}_nC_x(0.5)^{(n-x)}$ b) ${}_nC_n(0.5)^x$ c) ${}_nC_x(0.5)^x$ d) ${}_nC_x(0.5)^n$

34. The best fitted trend line is the one for which the sum of squares of errors is:
a) Zero b) Negative c) Maximum d) Minimum

35. Which measure of central tendency is most affected by extreme values (outliers)?
a) Median b) None of the above c) Mode d) Mean

36. If two events A and B are independent, then $P(A \cap B)$ equals:
a) P(A)/P(B) b) P(A) + P(B) c) P(A)·P(B) d) P(A) − P(B)

37. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Wider b) Narrower c) The same width d) Cannot be determined

38. The coefficient of determination R^2 measures:

a) None of the above b) The total unexplained variation in the model c) The proportion of variation in the independent variable explained by the dependent variable d) The proportion of variation in the dependent variable explained by the independent variable

39. A Type I error is also known as:

a) Sampling error b) Beta error c) Alpha error (false positive) d) Standard error

40. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:

a) Bayes' Theorem b) Law of Large Numbers c) Chebyshev's Inequality d) Central Limit Theorem

41. Which measure of central tendency is most affected by extreme values (outliers)?

a) Median b) Mean c) Mode d) None of the above

42. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?

a) 15 b) 125 c) 60 d) 10

43. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:

a) Variance of X b) Skewness of X c) Kurtosis of X d) Mean of X

44. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:

a) 1/8 b) 1/2 c) 3/8 d) 5/8

45. The p-value in hypothesis testing represents:

a) The probability of observing the data (or more extreme), given H_0 is true b) The probability that H_1 is true c) The significance level itself d) The probability that H_0 is true

46. In stratified sampling, the population is divided into:

a) Equal-sized random groups b) Homogeneous subgroups (strata) c) Systematic intervals d) Random clusters

47. In a binomial distribution, if the probability of success $\pi = 0.5$, then $Pr(X=x)$ is given by:

a) ${}_nC_x(0.5)^x$ b) ${}_nC_x(0.5)^n$ c) ${}_nC_n(0.5)^x$ d) ${}_nC_x(0.5)^{(n-x)}$

48. If the two observations are 15 and −15, then their harmonic mean is:

a) ∞ (undefined) b) −15 c) 15 d) 0

49. The binomial distribution tends to the normal distribution when:

a) $n \to \infty$, p fixed b) $p \to 0$, $n \to \infty$, np fixed c) $np \to \lambda$ (finite) d) $n \to 0$

50. In time series analysis, the mathematical method most commonly used for measuring trend is:

a) Semi-average method b) Least squares method c) Free-hand curve method d) Moving average method

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following is used to uniquely identify a device on a network?

a) Domain name b) URL c) HTML tag d) MAC address

52. Which SQL command removes a table completely from a database, including its structure?

a) DELETE b) TRUNCATE c) DROP d) REMOVE

53. Which subnet mask should be used to divide a Class C address into 4 subnets?

a) 255.255.255.224 b) 255.255.255.0 c) 255.255.255.128 d) 255.255.255.192

54. Which normal form removes partial dependency on a composite primary key?

a) 2NF b) 1NF c) BCNF d) 3NF

55. Which layer is responsible for routing data across different networks?

a) Network/Internet layer b) Application layer c) Data link layer d) Physical layer

56. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:

a) Abstraction b) Polymorphism c) Encapsulation d) Inheritance

57. Which data structure works on the LIFO (Last In First Out) principle?
a) Queue b) Stack c) Array d) Linked list

58. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) BCNF b) 4NF c) 1NF d) 2NF

59. Which of the following is a NoSQL database?
a) Oracle b) MySQL c) PostgreSQL d) MongoDB

60. Which of the following is an example of secondary memory?
a) Register b) Hard disk c) RAM d) Cache

61. Recursion in programming is best described as:
a) A loop with no exit condition b) A data structure c) A function calling itself to solve smaller instances of a problem d) A function that never returns

62. Which switching technique requires a dedicated path between sender and receiver?
a) None of the above b) Circuit switching c) Message switching d) Packet switching

63. Which of the following best describes cloud computing?
a) Delivering computing services (storage, servers, software) over the internet b) A type of programming language c) Storing data only on local computers d) A hardware component

64. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.128 b) 255.255.255.0 c) 255.255.255.192 d) 255.255.255.224

65. Which of the following is an entry-controlled loop?
a) None of the above b) while c) Both while and do-while d) do-while

66. The OSI model has how many layers?
a) 6 b) 5 c) 7 d) 8

67. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 1NF b) BCNF c) 2NF d) 4NF

68. Which of the following statements is executed by the preprocessor?
a) void main() b) return 0; c) #define PI 3.14 d) printf("Hello");

69. Which of the following statements is true regarding relational database keys?
a) A relation can have only one candidate key b) A relation can have only one foreign key c) A relation can have multiple candidate keys d) A relation can have only one primary key

70. Which of the following is the most common metric for measuring algorithm efficiency?
a) Memory size b) Lines of code c) Programming language used d) Time complexity (Big-O)

71. Which of the following is an example of secondary memory?
a) Register b) RAM c) Cache d) Hard disk

72. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) DROP c) TRUNCATE d) DELETE

73. Which diagram is used to represent the flow of data in structured software analysis?
a) Data Flow Diagram (DFD) b) Use-case diagram c) Class diagram d) Entity Relationship diagram

74. The time complexity of binary search on a sorted array of n elements is:
a) O(log n) b) O(1) c) O(n log n) d) O(n)

75. Which of the following information is required to normalize a relation into 3NF?
a) Join dependency b) Multivalued dependency c) None of the above d) Functional dependency

Section IV: Technical English (1×10=10)

76. Choose the correct comparative form: 'This problem is _____ than the previous one.'
a) more difficult b) difficult c) most difficult d) difficultest

77. 'By the time we arrived, the movie _____.'
a) already started b) has already started c) already starts d) had already started

78. Choose the correctly punctuated sentence:
a) It is'nt a nice day b) It's a nice day c) Its a nice day d) Its' a nice day

79. The synonym of 'abundant' is:
a) Rare b) Plentiful c) Scarce d) Limited

80. Which of the following is a compound sentence?
a) She sings well, and she dances gracefully. b) Because she practices, she sings well. c) Singing well is her passion. d) She sings well.

81. 'Actions speak louder than words' means:
a) What people do matters more than what they say b) Words are more powerful than actions c) Silence is golden d) Actions are always loud

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:
a) Education, healthcare, and employment b) Only entertainment c) None of the above d) Agriculture

83. Which of the following is mentioned as a challenge of urbanization?
a) Low population b) Traffic congestion c) Excess housing d) Abundant farmland

84. What does the passage suggest is essential for livable cities?
a) Banning public transport b) Removing green spaces c) Reducing population to zero d) Sustainable urban planning

85. The passage is primarily about:
a) The opportunities and challenges of urbanization b) Global warming c) The history of cities d) Rural life

Section V: Logical Reasoning (1×15=15)

86. Find the missing number: 2, 5, 10, 17, 26, ___
a) 37 b) 38 c) 35 d) 36

87. Find the odd one out:
a) Banana b) Mango c) Carrot d) Apple

88. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?
a) UBCLF b) UACMF c) TBCMF d) UBCMF

89. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 120 b) 98 c) 84 d) 112

90. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) None of the statements is true b) I, II, and III c) II and III only d) II only

91. Circle is to Sphere as Square is to:

a) Cylinder b) Rectangle c) Cube d) Cone

92. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Sunday b) Monday c) Friday d) Saturday

93. Statement: All students who study hard get good grades. Ram studies hard.

Conclusion: Ram gets good grades.

Does the conclusion follow?

a) Does not follow b) Partially follows c) Follows d) Cannot be determined

94. Which of the following is NOT a useful principle for making scientific progress?

a) Compare similar cases to isolate the relevant difference b) Actively seek disconfirming evidence as well c) Divide the problem into manageable components d) Look only for confirming evidence and ignore disconfirming evidence

95. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?

a) 18 b) 22 c) 20 d) 24

96. All cats are animals. No animal is a plant. Therefore:

a) No cat is a plant b) Some cats are plants c) All plants are animals d) No conclusion can be drawn

97. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 61 b) 65 c) 63 d) 67

98. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Father b) Uncle c) Grandfather d) Brother

99. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) DPH b) EPH c) EOH d) EPG

100. Fill in the blank: MBN NBO OBP PBQ _____

a) RBQ b) QBQ c) QBR d) PBR

Answer Key — Set 24

1	2	3	4	5	6	7	8	9	10
b	b	d	a	c	b	d	a	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	a	b	a	c	d	c	a	c	c
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	d	b	b	b	c	a	b	b	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	d	d	d	d	c	a	d	c	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
b	b	a	c	a	b	b	a	a	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
d	c	d	a	a	d	b	a	d	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	b	a	c	b	c	b	c	c	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	b	a	a	d	a	d	b	b	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	a	b	d	a	a	c	d	d	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
c	d	c	d	c	a	b	a	b	c

PRACTICE SET 25

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The radius of convergence of the series $\Sigma x^n/n!$ is:
a) 0 b) ∞ c) 1 d) e

2. The curve y = x^(1/3) at (0, 0) has:
a) A horizontal tangent b) No tangent c) An oblique tangent d) A vertical tangent

3. The nullity of a 4×4 identity matrix is:
a) 1 b) Undefined c) 0 d) 4

4. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Symmetric b) Orthogonal c) Singular d) Invertible

5. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 1 b) 0 c) 2 d) -1

6. The value of lim (x→0) (sin x)/x is:
a) 1 b) 0 c) Undefined d) ∞

7. The value of ∫₀^π sin x dx is:
a) π b) 0 c) 2 d) 1

8. The general solution of dy/dx = y/x is:
a) y = Cx b) y = C/x c) $y = Ce^x$ d) $y = Cx^2$

9. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative ∂f/∂x at point (1,1,1) is:
a) 1 b) 2 c) 0 d) 3

10. Let $f(x) = x^2$ for $x \leq 0$ and f(x) = x for x > 0. Then f is:
a) Differentiable at x = 0 b) Discontinuous at x = 0 c) Continuous but not differentiable at x = 0 d) An even function

11. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) 4e^(2x) b) e^(2x) c) −4e^(2x) d) 0

12. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 0 b) 2 c) 3 d) 1

13. Which of the following sets is countable?
a) Irrational numbers b) The interval [0, 1] c) Rational numbers d) Real numbers

14. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one and onto b) Onto but not one-one c) One-one but not onto d) Neither one-one nor onto

15. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π/2 b) π/4 c) π d) 1

16. The sequence $b_n = \Sigma_{k=1}^{n} 1/(n+k)$ converges to:
a) It diverges b) e c) ln 2 d) 1

17. The value of $\int e^x \cos x\,dx$ is:
a) $(e^x/2)(\sin x + \cos x) + C$ b) $e^x \cos x + C$ c) $e^x \sin x + C$ d) $(e^x/2)(\sin x - \cos x) + C$

18. The sum of the series Σ (from n=5 to ∞) $2^{(n+1)}/3^n$ is:
a) $3(2/3)^5$ b) $6(2/3)^5$ c) $2(2/3)^5$ d) $6(2/3)^4$

19. The number of one-one (injective) functions from a set of 5 elements to itself is:

a) 25 b) 120 c) 3125 d) 5

20. The derivative of ln(sin x) is:
a) sec x b) tan x c) cot x d) −cot x

21. The locus of the equation xz + yz = 0 is:
a) A pair of parallel planes b) A straight line c) A pair of perpendicular planes d) A single plane

22. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,1), v=(3,−1) b) u=(1,1), v=(1,1) c) u=(2,1), v=(1,2) d) u=(1,−1), v=(1,1)

23. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Undefined c) Zero d) Unity

24. Which of the following statements is true?
a) Every convergent sequence is bounded b) Every bounded sequence is convergent c) Every monotonic sequence converges d) Every sequence has a limit

25. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = Ae^{ix}$ b) $y = A\cos x + B\sin x$ c) $y = A + Bx$ d) $y = Ae^{x} + Be^{-x}$

Section II: Statistics (1×25=25)

26. The standard deviation of a distribution is always:
a) Negative b) Undefined c) Non-negative d) Zero

27. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Median b) Arithmetic mean c) Geometric mean d) Harmonic mean

28. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c b) r + c − 2 c) (r−1)(c−1) d) rc

29. In usual notation, if E(X) = 3 and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 4 c) 9 d) 2

30. The statistical test generally used to test association between two independent categorical variables is:
a) F-test b) t-test c) Chi-square test d) Z-test

31. The correlation coefficient r always lies between:
a) −1 and 1 b) 0 and 1 c) −∞ and ∞ d) 0 and ∞

32. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \le a)$ is computed using:
a) $Z = (a-\mu)/\sigma^2$ b) $Z = (a-\mu)/\sigma$ c) $Z = (a-\mu)\sigma$ d) $Z = (a-\mu)/\sqrt{n}$

33. The sum of squares of deviations is minimum when measured from the:
a) Mode b) Geometric mean c) Median d) Mean

34. Which distribution is used for testing the equality of two population variances?
a) F-distribution b) Normal distribution c) t-distribution d) Chi-square distribution

35. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 3 b) 5 c) 6 d) 4

36. The geometric mean of 2, 4, and 8 is:
a) 5 b) 8 c) 4.67 d) 4

37. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) 1/λ and $1/\lambda^2$ b) λ^2 and λ c) λ and λ^2 d) λ and λ

38. The standard normal distribution has mean and variance:
a) 1 and 1 b) 0 and 0 c) 0 and 1 d) 1 and 0

39. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided upper-tailed test b) One-sided lower-tailed test c) None of the above d) Two-tailed test

40. The probability of an impossible event is:
a) 0.5 b) Undefined c) 0 d) 1

41. For a Poisson distribution, which of the following is true?
a) Mean = Variance b) None of the above c) Mean < Variance d) Mean > Variance

42. The appropriate statistical test for comparing means across more than two independent groups is:
a) Z-test b) F-test (ANOVA) c) Chi-square test d) t-test

43. In hypothesis testing, a Type II error occurs when we:
a) Accept H_0 when H_0 is false b) Reject H_0 when H_0 is true c) None of the above d) Reject H_1 when H_1 is true

44. The best fitted trend line is the one for which the sum of squares of errors is:
a) Maximum b) Minimum c) Negative d) Zero

45. The variance of a constant c is:
a) c^2 b) 0 c) c d) Undefined

46. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Positive c) Zero d) Negative

47. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15.5 b) 23 c) 15 d) 16

48. If the correlation coefficient r = 0 between X and Y, it implies:
a) No relationship at all between X and Y b) A negative relationship between X and Y c) A perfect relationship between X and Y d) No linear relationship between X and Y

49. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ b) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ d) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$

50. In the hypergeometric distribution, the mean nK/N represents:
a) The variance b) The expected number of successes in the sample c) The mode d) The population mean

Section III: Computer Science and Information Technology (1×25=25)

51. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Persistence c) Fluorescence d) Refresh rate

52. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) SELECT, FROM, WHERE b) FROM, SELECT, WHERE c) FROM, WHERE, SELECT d) WHERE, SELECT, FROM

53. Which of the following is a valid IPv4 address?
a) 192.168.1.256 b) 192.168.1.1 c) 192.168.1.1.1 d) 192.168.1

54. A firewall is primarily used to:
a) Speed up an internet connection b) Control and filter network traffic for security c) Compress files d) Store data backups

55. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Stack b) Queue c) Graph d) Tree

56. Which system development approach is best suited when requirements evolve continuously?
a) Waterfall b) None of the above c) V-model d) Agile

57. Round-robin scheduling is the preemptive version of:
a) Priority Scheduling b) None of the above c) First Come First Serve (FCFS) d) Shortest Job First

58. Which of the following is used to uniquely identify a device on a network?
a) URL b) MAC address c) HTML tag d) Domain name

59. Which data structure works on the LIFO (Last In First Out) principle?
a) Stack b) Array c) Linked list d) Queue

60. HTTP stands for:
a) HyperText Transmission Process b) High Transfer Text Protocol c) HyperText Transfer Protocol d) Host Transfer Text Protocol

61. Which of the following is not a Database Management System?
a) MySQL b) PostgreSQL c) Windows d) Oracle

62. IP in the context of networking stands for:
a) Information Packet b) Internet Protocol c) Internal Process d) Interface Path

63. After a rollback, a transaction is in _____ state.
a) Active b) Committed c) Partially committed d) Aborted

64. A deadlock in an operating system occurs when:
a) None of the above b) A process completes execution c) Two or more processes wait indefinitely for resources held by each other d) A process uses too much CPU

65. Which protocol is used to send email?
a) HTTP b) SMTP c) SNMP d) FTP

66. Which normal form removes partial dependency on a composite primary key?
a) BCNF b) 1NF c) 2NF d) 3NF

67. The ability of objects to take on multiple forms is called:
a) Abstraction b) Encapsulation c) Inheritance d) Polymorphism

68. Which of the following is a compiled language?
a) C b) JavaScript c) Python d) PHP

69. In machine learning, overfitting refers to a model that:
a) Performs well on training data but poorly on new/unseen data b) Performs equally well on all datasets c) Cannot be trained at all d) Performs poorly on training data

70. The result of $(11010)_2 - (1011)_2$ is:
a) 01111 b) 01110 c) 11100 d) 10101

71. Which software is most commonly used for spreadsheet-based data analysis?
a) SPSS b) MS Paint c) MS Excel d) Photoshop

72. Which sorting algorithm has the best average-case time complexity among the following?
a) Quick sort b) Selection sort c) Insertion sort d) Bubble sort

73. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 5 b) 6 c) 10 d) 4

74. Which of the following is an example of supervised learning?
a) Principal Component Analysis b) Linear regression c) K-means clustering d) Association rule mining

75. A primary key can contain:
a) Only NULL values b) Neither duplicate nor NULL values c) NULL values d) Duplicate values

Section IV: Technical English (1×10=10)

76. The phrase 'in the nick of time' means:
a) In the near future b) At the very last possible moment c) At the beginning d) Too late

77. The antonym of 'diligent' is:

a) Hardworking b) Punctual c) Careful d) Lazy

78. Choose the correct passive voice of 'She is writing a letter.'

a) A letter was being written by her b) A letter has been written by her c) A letter is being written by her d) A letter is written by her

79. "He is the black sheep of the family." The underlined expression has …… meaning.

a) Poetic b) Literal c) Contextual d) Figurative

80. He asked me ……

a) where I lived b) that where do I live c) where I will live d) that where I lived

81. Choose the correctly spelled word:

a) Recieve b) Receiv c) Receve d) Receive

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:

a) Governments dislike renewable energy b) Fossil fuels are better than renewables c) Wind energy is the only alternative d) Renewable energy is gaining importance due to environmental benefits

83. The mode of approach in the passage is:

a) Narrative b) Descriptive c) Argumentative d) Poetic

84. According to the passage, one benefit of renewable energy is:

a) High cost b) Requiring fossil fuel input c) Low greenhouse gas emissions d) Limited availability

85. The most appropriate title for the passage is:

a) Solar Power Only b) Climate Change Effects c) The Decline of Fossil Fuels d) Renewable Energy: A Sustainable Future

Section V: Logical Reasoning (1×15=15)

86. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.

If the above are true, which must also be true?

I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly

a) None of the statements is true b) II and III only c) I, II, and III d) II only

87. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?

a) bowin b) ligowin c) winbo d) bota

88. Choose the word that does NOT belong with the others:

a) Triangle b) Cube c) Square d) Circle

89. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?

a) 18 b) 22 c) 20 d) 24

90. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?

a) EPG b) EOH c) DPH d) EPH

91. Look at this series: 3, 7, 15, 31, ___. What number should come next?

a) 61 b) 64 c) 62 d) 63

92. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Painting Found Near a Tree b) Tree Found Stolen Painting c) Painting Found Stolen by a Tree d) Tree Stole a Painting

93. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 63 b) 65 c) 61 d) 67

94. Fill in the blank: MBN NBO OBP PBQ _____

a) RBQ b) PBR c) QBR d) QBQ

95. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 44 b) 42 c) 36 d) 40

96. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Father b) Brother c) Uncle d) Grandfather

97. All cats are animals. No animal is a plant. Therefore:

a) No conclusion can be drawn b) All plants are animals c) No cat is a plant d) Some cats are plants

98. Circle is to Sphere as Square is to:

a) Cube b) Cone c) Rectangle d) Cylinder

99. Statement: All students who study hard get good grades. Ram studies hard.

Conclusion: Ram gets good grades.

Does the conclusion follow?

a) Follows b) Does not follow c) Partially follows d) Cannot be determined

100. Which of the following is NOT a useful principle for making scientific progress?

a) Divide the problem into manageable components b) Actively seek disconfirming evidence as well c) Look only for confirming evidence and ignore disconfirming evidence d) Compare similar cases to isolate the relevant difference

Answer Key — Set 25

1	2	3	4	5	6	7	8	9	10
b	d	c	c	a	a	c	a	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
d	c	c	c	b	c	a	b	b	c
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	a	c	a	b	c	c	c	d	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	b	d	a	b	d	d	c	a	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	b	a	b	b	b	a	d	a	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	c	b	b	b	d	c	b	a	c
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	b	d	c	b	c	d	a	a	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
c	a	a	b	b	b	d	c	d	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
d	d	b	c	d	b	a	b	c	d
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	a	b	c	b	a	c	a	a	c

PRACTICE SET 26

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Which of the following is an even function?
a) cos x b) x^3 c) sin x d) x

2. The determinant of a triangular matrix equals:
a) The sum of its diagonal elements b) The square of its trace c) The product of its diagonal elements d) Zero always

3. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 4/3 b) 6 c) 9 d) 3/4

4. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 1 b) 2 c) 3 d) 0

5. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Minimum b) Maximum c) Infimum d) Supremum

6. The curve y = x^(1/3) at (0, 0) has:
a) A vertical tangent b) An oblique tangent c) A horizontal tangent d) No tangent

7. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 0 b) 1 c) 3 d) 2

8. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) e^(2x) b) 4e^(2x) c) −4e^(2x) d) 0

9. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) 1 b) ∞ c) e d) 0

10. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Unity c) Zero d) Undefined

11. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x b) ln x c) 1/x d) x^2

12. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I and III only b) I only c) II only d) III only

13. The average value of $f(x) = x^2$ on the interval [0, 3] is:
a) 3 b) 9 c) 1 d) 27

14. The value of $\int_0^{\pi} \sin x\, dx$ is:
a) 1 b) π c) 0 d) 2

15. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,−1), v=(1,1) b) u=(2,1), v=(1,2) c) u=(1,1), v=(3,−1) d) u=(1,1), v=(1,1)

16. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Supremum b) Minimum c) Maximum d) Infimum

17. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 6 b) 3/4 c) 9 d) 4/3

18. The Laplace transform of sinh(3t) is:
a) $s/(s^2+9)$ b) $3/(s^2-9)$ c) $s/(s^2-9)$ d) $3/(s^2+9)$

19. The series $\Sigma\ 1/(n \ln n)$, $n \geq 2$, is:
a) Divergent b) Oscillatory c) Convergent d) Conditionally convergent

20. The value of $\lim (x \to 0) (\sin x)/x$ is:
a) Undefined b) ∞ c) 0 d) 1

21. The locus of the equation $xz + yz = 0$ is:
a) A pair of perpendicular planes b) A pair of parallel planes c) A straight line d) A single plane

22. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) -1 b) 2 c) 0 d) 1

23. The general solution of $dy/dx = y/x$ is:
a) $y = Cx$ b) $y = C/x$ c) $y = Cx^2$ d) $y = Ce^x$

24. The sum of the series Σ (from n=5 to ∞) $2^{(n+1)}/3^n$ is:
a) $2(2/3)^5$ b) $6(2/3)^5$ c) $6(2/3)^4$ d) $3(2/3)^5$

25. If A is a 3×3 matrix with $\det(A) = 0$, then A is:
a) Invertible b) Singular c) Symmetric d) Orthogonal

Section II: Statistics (1×25=25)

26. The coefficient of variation is computed using the formula:
a) (mean × s.d.)/100 b) (s.d./mean) × 100 c) (mean/s.d.) × 100 d) 100/(mean × s.d.)

27. In simple random sampling without replacement from a finite population, each unit has:
a) An unequal probability of selection b) An equal probability of selection c) A probability depending on order drawn d) Zero probability of selection

28. The chi-square test statistic can never be:
a) Negative b) Zero c) Positive d) A decimal value

29. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) $n^2/2$ b) $(n-1)/2$ c) $n/2$ d) $(n+1)/2$

30. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.1 b) 0.2 c) −0.2 d) 0.3

31. The best fitted trend line is the one for which the sum of squares of errors is:
a) Zero b) Minimum c) Maximum d) Negative

32. The geometric mean of 2, 4, and 8 is:
a) 4.67 b) 4 c) 5 d) 8

33. The chi-square test statistic can never be:
a) Negative b) Zero c) Positive d) A decimal value

34. The binomial distribution tends to the normal distribution when:
a) $np \to \lambda$ (finite) b) $p \to 0$, $n \to \infty$, np fixed c) $n \to 0$ d) $n \to \infty$, p fixed

35. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 1/2 b) 5/8 c) 1/8 d) 3/8

36. Which distribution is used for testing the equality of two population variances?
a) Chi-square distribution b) Normal distribution c) F-distribution d) t-distribution

37. In stratified sampling, the population is divided into:
a) Random clusters b) Systematic intervals c) Equal-sized random groups d) Homogeneous subgroups (strata)

38. The p-value in hypothesis testing represents:

a) The probability that H_0 is true b) The significance level itself c) The probability that H_1 is true d) The probability of observing the data (or more extreme), given H_0 is true

39. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.3 b) 0.2 c) −0.2 d) 0.1

40. The correlation coefficient r always lies between:
a) 0 and ∞ b) −∞ and ∞ c) −1 and 1 d) 0 and 1

41. The standard deviation of a distribution is always:
a) Non-negative b) Negative c) Undefined d) Zero

42. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Positive c) Zero d) Negative

43. In the hypergeometric distribution, the mean nK/N represents:
a) The mode b) The variance c) The population mean d) The expected number of successes in the sample

44. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) None of the above b) One-sided upper-tailed test c) One-sided lower-tailed test d) Two-tailed test

45. If the two observations are 15 and −15, then their harmonic mean is:
a) 0 b) 15 c) −15 d) ∞ (undefined)

46. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/2\}$ b) $1/\sqrt{2\pi}\ \exp\{-(x-10)^2/8\}$ c) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/2\}$ d) $1/(2\sqrt{2\pi})\ \exp\{-(x-10)^2/8\}$

47. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)/\sqrt{n}$ b) $Z = (a-\mu)\sigma$ c) $Z = (a-\mu)/\sigma^2$ d) $Z = (a-\mu)/\sigma$

48. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) (n+1)/2 b) n/2 c) (n−1)/2 d) $n^2/2$

49. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ^2 and λ b) λ and λ^2 c) λ and λ d) $1/\lambda$ and $1/\lambda^2$

50. In simple random sampling without replacement from a finite population, each unit has:
a) An unequal probability of selection b) A probability depending on order drawn c) Zero probability of selection d) An equal probability of selection

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following is a NoSQL database?
a) Oracle b) MySQL c) MongoDB d) PostgreSQL

52. Which layer is responsible for routing data across different networks?
a) Data link layer b) Physical layer c) Network/Internet layer d) Application layer

53. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Polymorphism b) Inheritance c) Encapsulation d) Abstraction

54. Which class of language is recognized by a pushdown automaton?
a) Regular language b) Context-free language c) Context-sensitive language d) Recursively enumerable language

55. Which SDLC phase focuses on gathering and documenting user requirements?
a) Maintenance b) Requirement Analysis c) Design d) Testing

56. Which system development approach is best suited when requirements evolve continuously?
a) None of the above b) Agile c) V-model d) Waterfall

57. Which sorting algorithm has the best average-case time complexity among the following?
a) Selection sort b) Quick sort c) Insertion sort d) Bubble sort

58. Which of the following is not a Database Management System?
a) Windows b) MySQL c) PostgreSQL d) Oracle

59. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) SELECT, FROM, WHERE b) FROM, WHERE, SELECT c) FROM, SELECT, WHERE d) WHERE, SELECT, FROM

60. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Queue c) Stack d) Tree

61. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) 4NF b) 2NF c) 1NF d) BCNF

62. Which of the following is used to uniquely identify a device on a network?
a) Domain name b) MAC address c) URL d) HTML tag

63. IP in the context of networking stands for:
a) Interface Path b) Information Packet c) Internal Process d) Internet Protocol

64. Which diagram is used to represent the flow of data in structured software analysis?
a) Data Flow Diagram (DFD) b) Entity Relationship diagram c) Use-case diagram d) Class diagram

65. The OSI model has how many layers?
a) 7 b) 6 c) 8 d) 5

66. Recursion in programming is best described as:
a) A data structure b) A function calling itself to solve smaller instances of a problem c) A function that never returns d) A loop with no exit condition

67. Which of the following statements is true regarding relational database keys?
a) A relation can have multiple candidate keys b) A relation can have only one candidate key c) A relation can have only one primary key d) A relation can have only one foreign key

68. A primary key can contain:
a) NULL values b) Neither duplicate nor NULL values c) Duplicate values d) Only NULL values

69. A deadlock in an operating system occurs when:
a) A process uses too much CPU b) A process completes execution c) Two or more processes wait indefinitely for resources held by each other d) None of the above

70. Which class of language is recognized by a pushdown automaton?
a) Recursively enumerable language b) Context-sensitive language c) Regular language d) Context-free language

71. Which of the following information is required to normalize a relation into 3NF?
a) Functional dependency b) None of the above c) Join dependency d) Multivalued dependency

72. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Refresh rate b) Phosphorescence c) Fluorescence d) Persistence

73. Which normal form removes partial dependency on a composite primary key?
a) BCNF b) 2NF c) 3NF d) 1NF

74. Which of the following is a NoSQL database?
a) MongoDB b) MySQL c) Oracle d) PostgreSQL

75. Which software is most commonly used for spreadsheet-based data analysis?
a) Photoshop b) MS Excel c) SPSS d) MS Paint

Section IV: Technical English (1×10=10)

76. Choose the word closest in meaning to 'meticulous':
a) Confused b) Careful and precise c) Careless d) Quick

77. Choose the correct comparative form: 'This problem is _____ than the previous one.'
a) more difficult b) difficult c) difficultest d) most difficult

78. Choose the correct form: 'One of the students _____ absent today.'
a) are b) were c) have been d) is

79. Identify the correctly punctuated sentence:
a) Although, it was raining we went for a walk. b) Although it was raining, we went for a walk. c) Although it was raining we, went for a walk. d) Although it was, raining we went for a walk.

80. Neither the teacher nor the students …… present.
a) has been b) is c) were d) was

81. "The thief was caught red-handed by the police." This means:
a) The thief was caught while committing the crime b) The thief was injured c) The police painted the thief's hand d) The thief's hands were painted red

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:
a) AI is only used in healthcare b) AI is too expensive c) AI cannot analyze data d) Job displacement and data privacy

83. According to the passage, what do experts recommend?
a) A balanced approach combining innovation and ethical safeguards b) Banning AI completely c) Using AI only in finance d) Ignoring privacy concerns

84. The tone of the passage is:
a) Purely critical b) Balanced and analytical c) Sarcastic d) Purely promotional

85. The most suitable title for the passage is:
a) Healthcare Systems Today b) The Dangers of Technology c) Artificial Intelligence: Opportunities and Challenges d) Finance in the Modern Age

Section V: Logical Reasoning (1×15=15)

86. Find the next term: 1, 4, 9, 16, 25, ___
a) 36 b) 30 c) 49 d) 32

87. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Both I and II follow b) Only conclusion II follows c) Only conclusion I follows d) Neither I nor II follows

88. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) Could you please close the door? b) He scored the highest marks in class c) Water boils at 100°C at sea level d) The Earth revolves around the Sun

89. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) Some Lazzies are not Razzies b) No Bloops are Lazzies c) All Bloops are Lazzies d) All Lazzies are Bloops

90. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) Both a and b b) No conclusion c) so d) since

91. Find the missing number: 2, 5, 10, 17, 26, ___

a) 37 b) 38 c) 35 d) 36

92. Which number should replace the question mark: 7, 14, 28, 56, ?

a) 120 b) 112 c) 84 d) 98

93. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Daughter b) Aunt c) Mother d) Sister

94. Find the odd one out:

a) Mango b) Apple c) Banana d) Carrot

95. Read the following carefully:

I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?

a) a is the uncle of c b) a is the brother of c c) a is the father of c d) a is the son of c

96. Statement: Regular exercise improves cardiovascular health and mental well-being.

Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?

a) Only conclusion I follows b) Only conclusion II follows c) Neither I nor II follows d) Both I and II follow

97. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UBCMF b) UACMF c) UBCLF d) TBCMF

98. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?

a) 24 b) 18 c) 20 d) 22

99. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?

a) Only conclusion I follows b) Neither I nor II follows c) Only conclusion II follows d) Both I and II follow

100. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Sunday b) Monday c) Friday d) Saturday

Answer Key — Set 26

1	2	3	4	5	6	7	8	9	10
a	c	d	b	c	a	c	d	b	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
a	a	a	d	c	d	b	b	a	d
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
a	d	a	b	b	b	b	a	d	b
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
b	b	a	d	d	c	d	d	b	c
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
a	b	d	b	d	d	d	a	c	d

51	52	53	54	55	56	57	58	59	60
c	c	b	b	b	b	b	a	b	b
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	b	d	a	a	b	a	b	c	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	c	b	a	b	b	a	d	b	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	d	a	b	c	a	c	a	c	c
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	b	d	d	a	a	a	c	a	d

PRACTICE SET 27

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 2 b) 1 c) 0 d) 3

2. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, −1 b) −1, −1 c) 0, 0 d) 1, 1

3. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) 1 b) π/4 c) π/2 d) π

4. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) 3/√34 b) 4/√34 c) 5/34 d) 5/√34

5. The nullity of a 4×4 identity matrix is:
a) Undefined b) 0 c) 1 d) 4

6. Let $f(x) = x^2$ for $x \le 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Differentiable at x = 0 b) An even function c) Discontinuous at x = 0 d) Continuous but not differentiable at x = 0

7. The derivative of ln(sin x) is:
a) cot x b) sec x c) tan x d) −cot x

8. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = A\cos x + B\sin x$ b) $y = Ae^{ix}$ c) $y = A + Bx$ d) $y = Ae^x + Be^{-x}$

9. Which of the following is an even function?
a) sin x b) cos x c) x d) x^3

10. A monotonic decreasing bounded sequence converges to its:
a) Supremum b) Upper bound c) Maximum d) Infimum

11. Which of the following statements is true?
a) Every sequence has a limit b) Every monotonic sequence converges c) Every convergent sequence is bounded d) Every bounded sequence is convergent

12. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 6, 0 c) 4, 2 d) 3, 3

13. A square matrix A is called orthogonal if:
a) det(A) = 0 b) $A = A^T$ c) $A^2 = I$ d) $A\,A^T = I$

14. The Wronskian of two linearly dependent functions is:
a) 1 b) −1 c) Undefined d) 0

15. Let f: (0,1) → (0,1) be defined by $f(x) = x^2$. Then f is:
a) One-one and onto b) One-one but not onto c) Neither one-one nor onto d) Onto but not one-one

16. If $f(x,y,z) = xy^2 + yz + x$, the partial derivative $\partial f/\partial x$ at point (1,1,1) is:
a) 3 b) 0 c) 1 d) 2

17. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A\,e^{9x} + B\,e^{-9x}$ b) $A\,e^{3x} + B\,e^{-3x}$ c) A cosh3x + B sinh3x d) A cos3x + B sin3x

18. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $e^x/2$ b) e^x c) $x\,e^x/2$ d) $x^2\,e^x$

19. The number of one-one (injective) functions from a set of 5 elements to itself is:

a) 5 b) 25 c) 120 d) 3125

20. A continuous function on a closed and bounded interval [a, b] is always:
a) Uniformly continuous on [a, b] b) Differentiable on [a, b] c) Monotonic on [a, b] d) Unbounded on [a, b]

21. The determinant of a triangular matrix equals:
a) The square of its trace b) The product of its diagonal elements c) Zero always d) The sum of its diagonal elements

22. The value of $\lim (n\to\infty) (1 + 1/n)^n$ is:
a) ∞ b) e c) 1 d) 0

23. The value of $\int e^x \cos x \, dx$ is:
a) $e^x \cos x + C$ b) $(e^x/2)(\sin x + \cos x) + C$ c) $(e^x/2)(\sin x - \cos x) + C$ d) $e^x \sin x + C$

24. Which of the following sets is countable?
a) The interval [0, 1] b) Rational numbers c) Irrational numbers d) Real numbers

25. The sequence $b_n = \Sigma_{k=1}^{n} 1/(n+k)$ converges to:
a) It diverges b) e c) 1 d) ln 2

Section II: Statistics (1×25=25)

26. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 4 b) 2 c) 13 d) 9

27. In a binomial distribution, if the probability of success $\pi = 0.5$, then $Pr(X=x)$ is given by:
a) ${}_nC_x(0.5)^{(n-x)}$ b) ${}_nC_x(0.5)^n$ c) ${}_nC_n(0.5)^x$ d) ${}_nC_x(0.5)^x$

28. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mean b) Mode c) None of the above d) Median

29. The coefficient of variation is computed using the formula:
a) 100/(mean × s.d.) b) (mean/s.d.) × 100 c) (s.d./mean) × 100 d) (mean × s.d.)/100

30. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Arithmetic mean b) Median c) Harmonic mean d) Geometric mean

31. The sum of squares of deviations is minimum when measured from the:
a) Median b) Mode c) Mean d) Geometric mean

32. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 3 b) 5 c) 4 d) 6

33. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Central Limit Theorem b) Law of Large Numbers c) Chebyshev's Inequality d) Bayes' Theorem

34. The statistical test generally used to test association between two independent categorical variables is:
a) F-test b) Z-test c) t-test d) Chi-square test

35. The coefficient of determination R^2 measures:
a) The proportion of variation in the dependent variable explained by the independent variable b) The total unexplained variation in the model c) The proportion of variation in the independent variable explained by the dependent variable d) None of the above

36. If the correlation coefficient $r = 0$ between X and Y, it implies:
a) No relationship at all between X and Y b) A perfect relationship between X and Y c) A negative relationship between X and Y d) No linear relationship between X and Y

37. The probability of an impossible event is:
a) 1 b) 0.5 c) Undefined d) 0

38. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Free-hand curve method b) Semi-average method c) Least squares method d) Moving average method

39. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15.5 b) 16 c) 23 d) 15

40. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Kurtosis of X b) Mean of X c) Skewness of X d) Variance of X

41. A Type I error is also known as:
a) Beta error b) Sampling error c) Alpha error (false positive) d) Standard error

42. The variance of a constant c is:
a) 0 b) c^2 c) c d) Undefined

43. The standard normal distribution has mean and variance:
a) 0 and 0 b) 1 and 0 c) 0 and 1 d) 1 and 1

44. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Narrower b) Cannot be determined c) Wider d) The same width

45. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) Z-test c) Chi-square test d) t-test

46. For a Poisson distribution, which of the following is true?
a) Mean = Variance b) Mean < Variance c) None of the above d) Mean > Variance

47. If two events A and B are independent, then $P(A \cap B)$ equals:
a) P(A) + P(B) b) P(A)·P(B) c) P(A) − P(B) d) P(A)/P(B)

48. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) r + c − 2 b) rc c) r + c d) (r−1)(c−1)

49. In hypothesis testing, a Type II error occurs when we:
a) None of the above b) Accept H_0 when H_0 is false c) Reject H_0 when H_0 is true d) Reject H_1 when H_1 is true

50. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 15 b) 125 c) 10 d) 60

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following statements is executed by the preprocessor?
a) #define PI 3.14 b) printf("Hello"); c) return 0; d) void main()

52. Round-robin scheduling is the preemptive version of:
a) Priority Scheduling b) None of the above c) Shortest Job First d) First Come First Serve (FCFS)

53. The result of $(11010)_2 - (1011)_2$ is:
a) 01110 b) 01111 c) 11100 d) 10101

54. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) REMOVE c) TRUNCATE d) DELETE

55. Which of the following is an example of supervised learning?
a) Association rule mining b) K-means clustering c) Principal Component Analysis d) Linear regression

56. Which of the following is an example of secondary memory?
a) Cache b) RAM c) Register d) Hard disk

57. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.128 b) 255.255.255.0 c) 255.255.255.224 d) 255.255.255.192

58. In machine learning, overfitting refers to a model that:

a) Cannot be trained at all b) Performs well on training data but poorly on new/unseen data c) Performs poorly on training data d) Performs equally well on all datasets

59. A firewall is primarily used to:

a) Compress files b) Speed up an internet connection c) Store data backups d) Control and filter network traffic for security

60. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:

a) Abstraction b) Encapsulation c) Polymorphism d) Inheritance

61. Which switching technique requires a dedicated path between sender and receiver?

a) None of the above b) Packet switching c) Message switching d) Circuit switching

62. HTTP stands for:

a) HyperText Transmission Process b) High Transfer Text Protocol c) HyperText Transfer Protocol d) Host Transfer Text Protocol

63. Which SDLC phase focuses on gathering and documenting user requirements?

a) Design b) Testing c) Requirement Analysis d) Maintenance

64. Which of the following is the most common metric for measuring algorithm efficiency?

a) Time complexity (Big-O) b) Lines of code c) Programming language used d) Memory size

65. How many times will the loop for(i=10; i>0; i-=2) execute?

a) 10 b) 5 c) 4 d) 6

66. Which of the following best describes cloud computing?

a) Delivering computing services (storage, servers, software) over the internet b) A hardware component c) Storing data only on local computers d) A type of programming language

67. Which of the following is a compiled language?

a) PHP b) Python c) JavaScript d) C

68. Which data structure works on the LIFO (Last In First Out) principle?

a) Queue b) Stack c) Array d) Linked list

69. The ability of objects to take on multiple forms is called:

a) Inheritance b) Encapsulation c) Abstraction d) Polymorphism

70. The time complexity of binary search on a sorted array of n elements is:

a) O(log n) b) O(n log n) c) O(n) d) O(1)

71. After a rollback, a transaction is in _____ state.

a) Aborted b) Committed c) Partially committed d) Active

72. Which protocol is used to send email?

a) SMTP b) HTTP c) FTP d) SNMP

73. Which of the following is an entry-controlled loop?

a) None of the above b) while c) do-while d) Both while and do-while

74. Which of the following is a valid IPv4 address?

a) 192.168.1.1 b) 192.168.1.1.1 c) 192.168.1.256 d) 192.168.1

75. Which layer is responsible for routing data across different networks?

a) Physical layer b) Network/Internet layer c) Data link layer d) Application layer

Section IV: Technical English (1×10=10)

76. 'By the time we arrived, the movie _____.'

a) already started b) already starts c) has already started d) had already started

77. The idiom 'to hit the nail on the head' means:
a) To work with tools b) To hurt someone c) To say or do something exactly right d) To make a mistake

78. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Verb b) Noun c) Adverb d) Adjective

79. 'He is used to _____ early.'
a) waking b) wake c) waken d) woke

80. 'He is used to _____ early.'
a) woke b) waking c) wake d) waken

81. Choose the correct passive voice of 'She is writing a letter.'
a) A letter is written by her b) A letter was being written by her c) A letter has been written by her d) A letter is being written by her

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:
a) Agriculture b) None of the above c) Education, healthcare, and employment d) Only entertainment

83. Which of the following is mentioned as a challenge of urbanization?
a) Abundant farmland b) Low population c) Excess housing d) Traffic congestion

84. What does the passage suggest is essential for livable cities?
a) Banning public transport b) Sustainable urban planning c) Reducing population to zero d) Removing green spaces

85. The passage is primarily about:
a) The history of cities b) Rural life c) Global warming d) The opportunities and challenges of urbanization

Section V: Logical Reasoning (1×15=15)

86. If the day before yesterday was Wednesday, what day will it be tomorrow?
a) Friday b) Sunday c) Monday d) Saturday

87. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?
a) Daughter b) Sister c) Mother d) Aunt

88. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Neither I nor II follows b) Only conclusion I follows c) Both I and II follow d) Only conclusion II follows

89. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 24 b) 22 c) 18 d) 20

90. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Neither I nor II follows b) Only conclusion I follows c) Both I and II follow d) Only conclusion II follows

91. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?

a) 36 b) 42 c) 40 d) 44

92. Look at the series: 5, 9, 17, 33, ___. What number should come next?

a) 63 b) 65 c) 67 d) 61

93. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) Both a and b b) so c) No conclusion d) since

94. Find the next term: 1, 4, 9, 16, 25, ___

a) 49 b) 30 c) 36 d) 32

95. If all Bloops are Razzies, and all Razzies are Lazzies, then:

a) All Bloops are Lazzies b) Some Lazzies are not Razzies c) No Bloops are Lazzies d) All Lazzies are Bloops

96. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?

a) UACMF b) UBCLF c) UBCMF d) TBCMF

97. Find the missing number: 2, 5, 10, 17, 26, ___

a) 37 b) 36 c) 35 d) 38

98. Which of the following is NOT a useful principle for making scientific progress?

a) Divide the problem into manageable components b) Look only for confirming evidence and ignore disconfirming evidence c) Actively seek disconfirming evidence as well d) Compare similar cases to isolate the relevant difference

99. Circle is to Sphere as Square is to:

a) Cone b) Cube c) Rectangle d) Cylinder

100. Fill in the blank: MBN NBO OBP PBQ _____

a) QBR b) RBQ c) QBQ d) PBR

Answer Key — Set 27

1	2	3	4	5	6	7	8	9	10
a	a	b	d	b	d	a	a	b	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	c	d	d	b	d	b	c	c	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
b	b	b	b	d	b	b	a	c	d
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
c	b	a	d	a	d	d	c	a	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	c	c	a	a	b	d	b	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
a	d	b	a	d	d	d	b	d	d
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
d	c	c	a	b	a	d	b	d	a
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	a	b	a	b	d	c	c	a	b
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
d	c	d	b	d	d	b	b	d	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
b	b	b	c	a	c	a	b	b	a

PRACTICE SET 28

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. Let f(x) = x² for x ≤ 0 and f(x) = x for x > 0. Then f is:
a) Discontinuous at x = 0 b) Differentiable at x = 0 c) An even function d) Continuous but not differentiable at x = 0

2. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Maximum b) Supremum c) Infimum d) Minimum

3. Complementary function of $(D^2 - 9)y = e^x$ is:
a) $A e^{3x} + B e^{-3x}$ b) A cosh3x + B sinh3x c) $A e^{9x} + B e^{-9x}$ d) A cos3x + B sin3x

4. The average value of f(x) = x² on the interval [0, 3] is:
a) 9 b) 3 c) 1 d) 27

5. If f(x,y,z) = xy² + yz + x, the partial derivative ∂f/∂x at point (1,1,1) is:
a) 3 b) 1 c) 0 d) 2

6. The particular integral of $(D^2 - 1)y = e^x$ is:
a) $x e^x/2$ b) $e^x/2$ c) $x^2 e^x$ d) e^x

7. The Wronskian of two linearly dependent functions is:
a) −1 b) 1 c) 0 d) Undefined

8. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 25 b) 5 c) 3125 d) 120

9. Let f: (0,1) → (0,1) be defined by f(x) = x². Then f is:
a) One-one and onto b) Onto but not one-one c) Neither one-one nor onto d) One-one but not onto

10. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, 1 b) 0, 0 c) 1, −1 d) −1, −1

11. The value of ∫₀^π sin x dx is:
a) 0 b) 1 c) 2 d) π

12. The general solution of dy/dx = y/x is:
a) y = Cx b) y = C/x c) $y = Ce^x$ d) $y = Cx^2$

13. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) e b) 0 c) ∞ d) 1

14. Let f(x) = |x − 1|. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) III only b) I and III only c) I only d) II only

15. The value of x from the equation $\log_3(x + 6) - \log_3 x = 2$ is:
a) 3/4 b) 9 c) 6 d) 4/3

16. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Symmetric b) Orthogonal c) Singular d) Invertible

17. The derivative of ln(sin x) is:
a) −cot x b) tan x c) cot x d) sec x

18. $\int_0^1 1/(1+x^2)\,dx$ equals:
a) π/2 b) π/4 c) 1 d) π

19. The sequence $b_n = \Sigma_{k=1}^{n}\ 1/(n+k)$ converges to:
a) 1 b) ln 2 c) e d) It diverges

20. The sum of the series Σ (from n=5 to ∞) 2^(n+1)/3ⁿ is:
a) $6(2/3)^4$ b) $2(2/3)^5$ c) $3(2/3)^5$ d) $6(2/3)^5$

21. A square matrix A is called orthogonal if:
a) $A^2 = I$ b) det(A) = 0 c) $A = A^T$ d) $A\ A^T = I$

22. The Laplace transform of sinh(3t) is:
a) $3/(s^2+9)$ b) $s/(s^2-9)$ c) $3/(s^2-9)$ d) $s/(s^2+9)$

23. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) e^(2x) b) 0 c) −4e^(2x) d) 4e^(2x)

24. Which of the following sets is countable?
a) Real numbers b) Rational numbers c) Irrational numbers d) The interval [0, 1]

25. The locus of the equation xz + yz = 0 is:
a) A pair of perpendicular planes b) A straight line c) A single plane d) A pair of parallel planes

Section II: Statistics (1×25=25)

26. The degrees of freedom for a chi-square test of independence in an r×c contingency table is:
a) (r−1)(c−1) b) rc c) r + c d) r + c − 2

27. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Geometric mean b) Arithmetic mean c) Harmonic mean d) Median

28. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 4 b) 5 c) 6 d) 3

29. The p-value in hypothesis testing represents:
a) The probability that H_1 is true b) The significance level itself c) The probability that H_0 is true d) The probability of observing the data (or more extreme), given H_0 is true

30. The chi-square test statistic can never be:
a) Zero b) A decimal value c) Negative d) Positive

31. The coefficient of determination R^2 measures:
a) The proportion of variation in the dependent variable explained by the independent variable b) The proportion of variation in the independent variable explained by the dependent variable c) None of the above d) The total unexplained variation in the model

32. The coefficient of variation is computed using the formula:
a) (s.d./mean) × 100 b) 100/(mean × s.d.) c) (mean × s.d.)/100 d) (mean/s.d.) × 100

33. If an increase in X is accompanied by an increase in Y, the correlation coefficient between X and Y is always:
a) Unity b) Zero c) Negative d) Positive

34. The sum of squares of deviations is minimum when measured from the:
a) Median b) Mean c) Geometric mean d) Mode

35. The standard normal distribution has mean and variance:
a) 0 and 1 b) 1 and 1 c) 0 and 0 d) 1 and 0

36. The correlation coefficient r always lies between:
a) 0 and 1 b) 0 and ∞ c) −∞ and ∞ d) −1 and 1

37. How many possible samples can be formed by selecting 3 samples at a time out of a population of size 5, with replacement?
a) 15 b) 60 c) 10 d) 125

38. The best fitted trend line is the one for which the sum of squares of errors is:
a) Minimum b) Maximum c) Zero d) Negative

39. In the hypergeometric distribution, the mean nK/N represents:
a) The population mean b) The expected number of successes in the sample c) The variance d) The mode

40. If the two observations are 15 and −15, then their harmonic mean is:
a) −15 b) ∞ (undefined) c) 0 d) 15

41. The standard deviation of a distribution is always:
a) Undefined b) Negative c) Non-negative d) Zero

42. A Type I error is also known as:
a) Alpha error (false positive) b) Beta error c) Sampling error d) Standard error

43. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) \cdot P(B)$ b) $P(A) + P(B)$ c) $P(A) - P(B)$ d) $P(A)/P(B)$

44. In a binomial distribution, if the probability of success $\pi = 0.5$, then $Pr(X=x)$ is given by:
a) ${}_nC_x(0.5)^n$ b) ${}_nC_x(0.5)^{(n-x)}$ c) ${}_nC_x(0.5)^x$ d) ${}_nC_n(0.5)^x$

45. The expected value of a discrete uniform distribution over {1, 2, ..., n} is:
a) n/2 b) (n−1)/2 c) $n^2/2$ d) (n+1)/2

46. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided upper-tailed test b) None of the above c) Two-tailed test d) One-sided lower-tailed test

47. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Law of Large Numbers b) Chebyshev's Inequality c) Central Limit Theorem d) Bayes' Theorem

48. The variance of a constant c is:
a) 0 b) Undefined c) c d) c^2

49. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) −0.2 b) 0.3 c) 0.2 d) 0.1

50. The statistical test generally used to test association between two independent categorical variables is:
a) Chi-square test b) Z-test c) t-test d) F-test

Section III: Computer Science and Information Technology (1×25=25)

51. Which of the following is not a Database Management System?
a) PostgreSQL b) Oracle c) Windows d) MySQL

52. Which class of language is recognized by a pushdown automaton?
a) Recursively enumerable language b) Regular language c) Context-sensitive language d) Context-free language

53. Which of the following information is required to normalize a relation into 3NF?
a) Multivalued dependency b) Functional dependency c) Join dependency d) None of the above

54. Round-robin scheduling is the preemptive version of:
a) Shortest Job First b) None of the above c) Priority Scheduling d) First Come First Serve (FCFS)

55. The OSI model has how many layers?
a) 7 b) 8 c) 6 d) 5

56. In machine learning, overfitting refers to a model that:
a) Performs equally well on all datasets b) Performs poorly on training data c) Performs well on training data but poorly on new/unseen data d) Cannot be trained at all

57. Which normal form removes partial dependency on a composite primary key?
a) 2NF b) 3NF c) 1NF d) BCNF

58. Which of the following is an example of supervised learning?
a) K-means clustering b) Linear regression c) Association rule mining d) Principal Component Analysis

59. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) SELECT, FROM, WHERE b) FROM, WHERE, SELECT c) WHERE, SELECT, FROM d) FROM, SELECT, WHERE

60. The result of $(11010)_2 - (1011)_2$ is:
a) 01111 b) 11100 c) 01110 d) 10101

61. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Stack c) Queue d) Tree

62. A primary key can contain:
a) NULL values b) Neither duplicate nor NULL values c) Duplicate values d) Only NULL values

63. Which layer is responsible for routing data across different networks?
a) Application layer b) Physical layer c) Data link layer d) Network/Internet layer

64. Which of the following best describes cloud computing?
a) Storing data only on local computers b) A type of programming language c) A hardware component d) Delivering computing services (storage, servers, software) over the internet

65. Which sorting algorithm has the best average-case time complexity among the following?
a) Bubble sort b) Quick sort c) Selection sort d) Insertion sort

66. A firewall is primarily used to:
a) Speed up an internet connection b) Store data backups c) Control and filter network traffic for security d) Compress files

67. Which subnet mask should be used to divide a Class C address into 4 subnets?
a) 255.255.255.224 b) 255.255.255.192 c) 255.255.255.128 d) 255.255.255.0

68. Which of the following is a NoSQL database?
a) MySQL b) PostgreSQL c) Oracle d) MongoDB

69. Which SQL command removes a table completely from a database, including its structure?
a) REMOVE b) DROP c) TRUNCATE d) DELETE

70. How many times will the loop for(i=10; i>0; i-=2) execute?
a) 6 b) 4 c) 10 d) 5

71. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) BCNF b) 4NF c) 1NF d) 2NF

72. Which of the following statements is executed by the preprocessor?
a) printf("Hello"); b) #define PI 3.14 c) return 0; d) void main()

73. Which data structure works on the LIFO (Last In First Out) principle?
a) Queue b) Array c) Stack d) Linked list

74. The ability of objects to take on multiple forms is called:
a) Encapsulation b) Inheritance c) Polymorphism d) Abstraction

75. Which of the following is the most common metric for measuring algorithm efficiency?
a) Programming language used b) Time complexity (Big-O) c) Memory size d) Lines of code

Section IV: Technical English (1×10=10)

76. Choose the correct form: 'One of the students _____ absent today.'
a) have been b) were c) is d) are

77. The phrase 'in the nick of time' means:
a) At the beginning b) Too late c) In the near future d) At the very last possible moment

78. Choose the correctly punctuated sentence:
a) Its' a nice day b) Its a nice day c) It is'nt a nice day d) It's a nice day

79. The synonym of 'abundant' is:
a) Scarce b) Plentiful c) Limited d) Rare

80. He asked me ……
a) where I lived b) where I will live c) that where do I live d) that where I lived

81. "She always works diligently." The part of speech of the underlined word 'diligently' is:
a) Verb b) Adjective c) Adverb d) Noun

Read the passage below and answer the questions that follow.

Renewable energy sources such as solar, wind, and hydro power are gaining global attention due to their environmental benefits. Unlike fossil fuels, these sources do not deplete over time and produce little to no greenhouse gas emissions. Governments worldwide are investing heavily in renewable infrastructure to combat climate change and reduce dependency on non-renewable resources.

82. The main idea of the passage is:
a) Fossil fuels are better than renewables b) Renewable energy is gaining importance due to environmental benefits
c) Governments dislike renewable energy d) Wind energy is the only alternative

83. The mode of approach in the passage is:
a) Argumentative b) Descriptive c) Poetic d) Narrative

84. According to the passage, one benefit of renewable energy is:
a) Low greenhouse gas emissions b) High cost c) Requiring fossil fuel input d) Limited availability

85. The most appropriate title for the passage is:
a) Solar Power Only b) Renewable Energy: A Sustainable Future c) The Decline of Fossil Fuels d) Climate Change Effects

Section V: Logical Reasoning (1×15=15)

86. All cats are animals. No animal is a plant. Therefore:
a) No conclusion can be drawn b) No cat is a plant c) Some cats are plants d) All plants are animals

87. Choose the word that does NOT belong with the others:
a) Triangle b) Square c) Circle d) Cube

88. Find the odd one out:
a) Mango b) Carrot c) Apple d) Banana

89. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 64 b) 62 c) 61 d) 63

90. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Follows b) Does not follow c) Partially follows d) Cannot be determined

91. Read the following carefully:
I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q

IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?
a) a is the father of c b) a is the uncle of c c) a is the son of c d) a is the brother of c

92. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?
a) EPG b) EPH c) EOH d) DPH

93. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) winbo b) bowin c) ligowin d) bota

94. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?
a) Grandfather b) Brother c) Father d) Uncle

95. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) I, II, and III b) II and III only c) None of the statements is true d) II only

96. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 24 b) 18 c) 22 d) 20

97. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) He scored the highest marks in class b) Water boils at 100°C at sea level c) The Earth revolves around the Sun d) Could you please close the door?

98. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 98 b) 84 c) 120 d) 112

99. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?
a) Tree Found Stolen Painting b) Painting Found Near a Tree c) Tree Stole a Painting d) Painting Found Stolen by a Tree

100. Statement: The company reported record profits this quarter despite the economic slowdown.
Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Only conclusion I follows b) Both I and II follow c) Only conclusion II follows d) Neither I nor II follows

Answer Key — Set 28

1	2	3	4	5	6	7	8	9	10
d	c	a	b	d	a	c	d	d	c
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	a	a	b	a	c	c	b	b	d
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
d	c	b	b	a	a	a	b	d	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	a	d	b	a	d	d	a	b	b
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	a	a	d	a	c	a	c	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
c	d	b	d	a	c	a	b	b	a
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	b	d	d	b	c	b	d	b	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
a	b	c	c	b	c	d	d	b	a
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**

c	b	b	a	b	b	d	b	d	a
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
b	b	b	c	b	d	d	d	b	a

PRACTICE SET 29

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The nullity of a 4×4 identity matrix is:
a) 1 b) 0 c) Undefined d) 4

2. The curve y = x^(1/3) at (0, 0) has:
a) A vertical tangent b) An oblique tangent c) No tangent d) A horizontal tangent

3. Which of the following statements is true?
a) Every convergent sequence is bounded b) Every sequence has a limit c) Every monotonic sequence converges d) Every bounded sequence is convergent

4. The determinant of a triangular matrix equals:
a) The sum of its diagonal elements b) Zero always c) The product of its diagonal elements d) The square of its trace

5. A monotonic decreasing bounded sequence converges to its:
a) Infimum b) Maximum c) Supremum d) Upper bound

6. The general solution of the homogeneous equation $(D^2 + 1)y = 0$ is:
a) $y = Ae^x + Be^{-x}$ b) $y = Ae^{ix}$ c) $y = A + Bx$ d) $y = A\cos x + B\sin x$

7. Which of the following is an even function?
a) sin x b) x^3 c) x d) cos x

8. The rank of the matrix [[1,2,3],[2,4,6],[1,1,1]] is:
a) 3 b) 2 c) 0 d) 1

9. The value of $\int e^x \cos x\, dx$ is:
a) $e^x \cos x + C$ b) $e^x \sin x + C$ c) $(e^x/2)(\sin x - \cos x) + C$ d) $(e^x/2)(\sin x + \cos x) + C$

10. The integrating factor of the differential equation $dy/dx + y/x = x^2$ is:
a) x b) x^2 c) ln x d) 1/x

11. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Unity c) Zero d) Undefined

12. The projection of the vector $\hat{i} + 2\hat{j} - 2\hat{k}$ on the line joining the points (1,0,0) and (4,4,3) is:
a) $4/\sqrt{34}$ b) $5/34$ c) $5/\sqrt{34}$ d) $3/\sqrt{34}$

13. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 4, 2 b) 2, −2 c) 6, 0 d) 3, 3

14. The radius of convergence of the series $\Sigma\, x^n/n!$ is:
a) 0 b) e c) 1 d) ∞

15. A continuous function on a closed and bounded interval [a, b] is always:
a) Uniformly continuous on [a, b] b) Unbounded on [a, b] c) Monotonic on [a, b] d) Differentiable on [a, b]

16. With inner product $\langle u,v\rangle = x_1y_1 + 3x_2y_2$ in R^2, which pair of vectors is orthogonal?
a) u=(1,−1), v=(1,1) b) u=(1,1), v=(1,1) c) u=(2,1), v=(1,2) d) u=(1,1), v=(3,−1)

17. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) 2 b) 1 c) 0 d) -1

18. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) 0 b) 1 c) Undefined d) ∞

19. The series $\Sigma\, 1/(n \ln n)$, $n \geq 2$, is:

a) Oscillatory b) Divergent c) Convergent d) Conditionally convergent

20. Divergence of the vector field $F = x\hat{i} + y\hat{j} + z\hat{k}$ is:
a) 0 b) 3 c) 1 d) 2

21. If y = e^(2x), then the value of y'' − 4y' + 4y is:
a) −4e^(2x) b) 4e^(2x) c) 0 d) e^(2x)

22. The curve y = x^(1/3) at (0, 0) has:
a) No tangent b) An oblique tangent c) A horizontal tangent d) A vertical tangent

23. Which of the following statements is true?
a) Every convergent sequence is bounded b) Every bounded sequence is convergent c) Every sequence has a limit d) Every monotonic sequence converges

24. Curl of the gradient of a scalar function is always:
a) Equal to its divergence b) Undefined c) Unity d) Zero

25. The eigenvalues of the matrix [[0,1],[1,0]] are:
a) 1, −1 b) 0, 0 c) 1, 1 d) −1, −1

Section II: Statistics (1×25=25)

26. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Kurtosis of X b) Variance of X c) Mean of X d) Skewness of X

27. Which distribution is used for testing the equality of two population variances?
a) Normal distribution b) F-distribution c) Chi-square distribution d) t-distribution

28. In time series analysis, the mathematical method most commonly used for measuring trend is:
a) Moving average method b) Free-hand curve method c) Least squares method d) Semi-average method

29. The geometric mean of 2, 4, and 8 is:
a) 4 b) 4.67 c) 5 d) 8

30. In simple random sampling without replacement from a finite population, each unit has:
a) An equal probability of selection b) A probability depending on order drawn c) Zero probability of selection d) An unequal probability of selection

31. If the correlation coefficient r = 0 between X and Y, it implies:
a) No relationship at all between X and Y b) A negative relationship between X and Y c) A perfect relationship between X and Y d) No linear relationship between X and Y

32. For a Poisson distribution, which of the following is true?
a) None of the above b) Mean < Variance c) Mean = Variance d) Mean > Variance

33. If a random variable X follows a normal distribution with mean μ and variance σ^2, $P(X \leq a)$ is computed using:
a) $Z = (a-\mu)\sigma$ b) $Z = (a-\mu)/\sigma^2$ c) $Z = (a-\mu)/\sqrt{n}$ d) $Z = (a-\mu)/\sigma$

34. The probability density function of a normal random variate X with mean 10 and variance 4 is:
a) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/8\}$ b) $1/\sqrt{2\pi}\exp\{-(x-10)^2/8\}$ c) $1/\sqrt{2\pi}\exp\{-(x-10)^2/2\}$ d) $1/(2\sqrt{2\pi})\exp\{-(x-10)^2/2\}$

35. The binomial distribution tends to the normal distribution when:
a) $p \to 0, n \to \infty$, np fixed b) $n \to 0$ c) $np \to \lambda$ (finite) d) $n \to \infty$, p fixed

36. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Wider b) The same width c) Narrower d) Cannot be determined

37. In hypothesis testing, a Type II error occurs when we:
a) Accept H_0 when H_0 is false b) Reject H_0 when H_0 is true c) None of the above d) Reject H_1 when H_1 is true

38. In stratified sampling, the population is divided into:
a) Equal-sized random groups b) Random clusters c) Homogeneous subgroups (strata) d) Systematic intervals

39. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 2 b) 4 c) 13 d) 9

40. Which measure of central tendency is most affected by extreme values (outliers)?
a) Median b) Mode c) None of the above d) Mean

41. The probability of an impossible event is:
a) 0.5 b) Undefined c) 0 d) 1

42. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 5/8 c) 1/8 d) 1/2

43. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ^2 and λ b) λ and λ c) λ and λ^2 d) $1/\lambda$ and $1/\lambda^2$

44. The appropriate statistical test for comparing means across more than two independent groups is:
a) F-test (ANOVA) b) Chi-square test c) t-test d) Z-test

45. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 15.5 b) 16 c) 15 d) 23

46. The p-value in hypothesis testing represents:
a) The significance level itself b) The probability that H_0 is true c) The probability that H_1 is true d) The probability of observing the data (or more extreme), given H_0 is true

47. The variance of a constant c is:
a) Undefined b) 0 c) c d) c^2

48. In stratified sampling, the population is divided into:
a) Systematic intervals b) Random clusters c) Homogeneous subgroups (strata) d) Equal-sized random groups

49. The coefficient of variation is computed using the formula:
a) (s.d./mean) × 100 b) 100/(mean × s.d.) c) (mean/s.d.) × 100 d) (mean × s.d.)/100

50. In hypothesis testing, a Type II error occurs when we:
a) None of the above b) Accept H_0 when H_0 is false c) Reject H_1 when H_1 is true d) Reject H_0 when H_0 is true

Section III: Computer Science and Information Technology (1×25=25)

51. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Fluorescence c) Refresh rate d) Persistence

52. Which of the following statements is true regarding relational database keys?
a) A relation can have multiple candidate keys b) A relation can have only one candidate key c) A relation can have only one foreign key d) A relation can have only one primary key

53. Which protocol is used to send email?
a) FTP b) SNMP c) SMTP d) HTTP

54. HTTP stands for:
a) Host Transfer Text Protocol b) HyperText Transmission Process c) HyperText Transfer Protocol d) High Transfer Text Protocol

55. The time complexity of binary search on a sorted array of n elements is:
a) O(1) b) O(log n) c) O(n) d) O(n log n)

56. Which SDLC phase focuses on gathering and documenting user requirements?
a) Maintenance b) Design c) Requirement Analysis d) Testing

57. Which of the following is a valid IPv4 address?
a) 192.168.1.1 b) 192.168.1.1.1 c) 192.168.1.256 d) 192.168.1

58. IP in the context of networking stands for:
a) Information Packet b) Interface Path c) Internal Process d) Internet Protocol

59. A deadlock in an operating system occurs when:
a) None of the above b) A process completes execution c) A process uses too much CPU d) Two or more processes wait indefinitely for resources held by each other

60. Which diagram is used to represent the flow of data in structured software analysis?
a) Entity Relationship diagram b) Class diagram c) Data Flow Diagram (DFD) d) Use-case diagram

61. Which of the following is a compiled language?
a) Python b) C c) JavaScript d) PHP

62. Which of the following is used to uniquely identify a device on a network?
a) HTML tag b) MAC address c) URL d) Domain name

63. In object-oriented programming, the mechanism of deriving a new class from an existing class is called:
a) Encapsulation b) Inheritance c) Polymorphism d) Abstraction

64. Which of the following is an example of secondary memory?
a) RAM b) Cache c) Register d) Hard disk

65. Recursion in programming is best described as:
a) A loop with no exit condition b) A function calling itself to solve smaller instances of a problem c) A data structure d) A function that never returns

66. Which switching technique requires a dedicated path between sender and receiver?
a) None of the above b) Circuit switching c) Packet switching d) Message switching

67. Which system development approach is best suited when requirements evolve continuously?
a) Waterfall b) None of the above c) V-model d) Agile

68. After a rollback, a transaction is in _____ state.
a) Partially committed b) Committed c) Aborted d) Active

69. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Paint b) MS Excel c) Photoshop d) SPSS

70. Which of the following is an entry-controlled loop?
a) Both while and do-while b) while c) do-while d) None of the above

71. Which of the following statements is true regarding relational database keys?
a) A relation can have only one candidate key b) A relation can have only one foreign key c) A relation can have multiple candidate keys d) A relation can have only one primary key

72. A firewall is primarily used to:
a) Speed up an internet connection b) Store data backups c) Compress files d) Control and filter network traffic for security

73. Which data structure is typically used for Breadth-First Search (BFS) traversal?
a) Graph b) Queue c) Stack d) Tree

74. Which of the following is an example of secondary memory?
a) Cache b) Register c) Hard disk d) RAM

75. Which data structure works on the LIFO (Last In First Out) principle?
a) Queue b) Stack c) Array d) Linked list

Section IV: Technical English (1×10=10)

76. "The thief was caught red-handed by the police." This means:

a) The thief was injured b) The thief's hands were painted red c) The thief was caught while committing the crime d) The police painted the thief's hand

77. The antonym of 'diligent' is:

a) Punctual b) Hardworking c) Lazy d) Careful

78. Neither the teacher nor the students …… present.

a) has been b) were c) is d) was

79. Which of the following is a compound sentence?

a) Singing well is her passion. b) She sings well, and she dances gracefully. c) Because she practices, she sings well. d) She sings well.

80. The idiom 'to hit the nail on the head' means:

a) To work with tools b) To make a mistake c) To say or do something exactly right d) To hurt someone

81. Choose the word closest in meaning to 'meticulous':

a) Careful and precise b) Confused c) Quick d) Careless

Read the passage below and answer the questions that follow.

Artificial intelligence (AI) is transforming industries ranging from healthcare to finance. By analyzing vast amounts of data, AI systems can identify patterns that would be difficult for humans to detect. However, concerns about job displacement and data privacy have prompted calls for stronger regulation. Experts argue that a balanced approach, combining innovation with ethical safeguards, is necessary for AI to benefit society as a whole.

82. The main concern raised in the passage regarding AI is:

a) Job displacement and data privacy b) AI is too expensive c) AI cannot analyze data d) AI is only used in healthcare

83. According to the passage, what do experts recommend?

a) Banning AI completely b) A balanced approach combining innovation and ethical safeguards c) Ignoring privacy concerns d) Using AI only in finance

84. The tone of the passage is:

a) Purely promotional b) Purely critical c) Balanced and analytical d) Sarcastic

85. The most suitable title for the passage is:

a) The Dangers of Technology b) Artificial Intelligence: Opportunities and Challenges c) Finance in the Modern Age d) Healthcare Systems Today

Section V: Logical Reasoning (1×15=15)

86. Find the odd one out:

a) Mango b) Carrot c) Banana d) Apple

87. What is the conclusion indicator term in this passage, if there is one? "The road was icy, so the driver slowed down since he heard about the accident ahead."

a) Both a and b b) since c) so d) No conclusion

88. Read the following carefully:

I. P+Q means P is the son of Q
II. P−Q means P is the wife of Q
III. P×Q means P is the brother of Q
IV. P÷Q means P is the mother of Q
V. P=Q means P is the sister of Q
What does a×b÷c mean?

a) a is the son of c b) a is the father of c c) a is the uncle of c d) a is the brother of c

89. A is the brother of B. C is the mother of A. D is the father of B. If C and D are married, what is D to A?

a) Brother b) Uncle c) Father d) Grandfather

90. Look at this series: 2, 6, 12, 20, 30, ___. What number should come next?
a) 40 b) 42 c) 36 d) 44

91. If 'CAT' is coded as 'DBU' (each letter shifted forward by one), how is 'DOG' coded in the same way?
a) EPH b) EPG c) DPH d) EOH

92. Which sentence below is probably not being used to make a claim (that is, a statement)?
a) He scored the highest marks in class b) Could you please close the door? c) Water boils at 100°C at sea level d) The Earth revolves around the Sun

93. Look at the series: 5, 9, 17, 33, ___. What number should come next?
a) 65 b) 63 c) 67 d) 61

94. Statement: All students who study hard get good grades. Ram studies hard.
Conclusion: Ram gets good grades.
Does the conclusion follow?
a) Cannot be determined b) Follows c) Does not follow d) Partially follows

95. Look at this series: 3, 7, 15, 31, ___. What number should come next?
a) 61 b) 64 c) 62 d) 63

96. Look at the series: 6, 36, 13, 34, ___, 32, 27. What number should fill the blank?
a) 24 b) 18 c) 22 d) 20

97. Statement: Some pens are pencils. All pencils are erasers.
Conclusion I: Some pens are erasers.
Conclusion II: All erasers are pencils.
Which one is true?
a) Only conclusion I follows b) Both I and II follow c) Only conclusion II follows d) Neither I nor II follows

98. In an artificial language: "tarligo" means "sunlight", "boligo" means "moonlight", "tarwin" means "sunrise". Which word could mean "moonrise"?
a) bota b) ligowin c) winbo d) bowin

99. Which of the following is NOT a useful principle for making scientific progress?
a) Actively seek disconfirming evidence as well b) Look only for confirming evidence and ignore disconfirming evidence c) Divide the problem into manageable components d) Compare similar cases to isolate the relevant difference

100. In a row of children, A is 7th from the left and B is 9th from the right. If they interchange positions, A becomes 12th from the left. How many children are there in the row?
a) 22 b) 24 c) 20 d) 18

Answer Key — Set 29

1	2	3	4	5	6	7	8	9	10
b	a	a	c	a	d	d	b	d	a
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
c	c	a	d	a	d	b	b	b	b
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
c	d	a	d	a	b	b	c	a	a
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
d	c	d	a	d	a	a	c	a	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
c	a	b	a	a	d	b	c	a	b
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
b	a	c	c	b	c	a	d	d	c
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
b	b	b	d	b	b	d	c	b	b
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**

c	d	b	c	b	c	c	b	b	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	a	b	c	b	b	c	c	c	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
a	b	a	b	d	d	a	d	b	c

PRACTICE SET 30

Full Marks: 100 *Time: 2:00 Hrs* *No negative marking*

Section I: Mathematics (1×25=25)

1. The number of one-one (injective) functions from a set of 5 elements to itself is:
a) 5 b) 120 c) 25 d) 3125

2. The slope of the tangent at the origin for the curve $y = \sin x + x^2$ is:
a) -1 b) 2 c) 0 d) 1

3. The nullity of a 4×4 identity matrix is:
a) 0 b) 4 c) Undefined d) 1

4. Which of the following is an even function?
a) x b) cos x c) sin x d) x^3

5. Let $f(x) = |x - 1|$. Which of the following about f at x = 1 is/are true?
I. Continuous II. Differentiable III. Has a relative minimum
a) I only b) II only c) I and III only d) III only

6. The sum of the series Σ (from n=5 to ∞) $2^{(n+1)}/3^n$ is:
a) $2(2/3)^5$ b) $6(2/3)^4$ c) $3(2/3)^5$ d) $6(2/3)^5$

7. Let $f(x) = x^2$ for $x \leq 0$ and $f(x) = x$ for $x > 0$. Then f is:
a) Continuous but not differentiable at x = 0 b) Discontinuous at x = 0 c) An even function d) Differentiable at x = 0

8. The value of $\lim_{n\to\infty} (1 + 1/n)^n$ is:
a) ∞ b) 0 c) 1 d) e

9. A square matrix A is called orthogonal if:
a) $A^2 = I$ b) $A\,A^T = I$ c) $\det(A) = 0$ d) $A = A^T$

10. The value of $\lim_{x\to 0} (\sin x)/x$ is:
a) Undefined b) 0 c) ∞ d) 1

11. Complementary function of $(D^2 - 9)y = e^x$ is:
a) A cosh3x + B sinh3x b) $A\,e^{3x} + B\,e^{-3x}$ c) A cos3x + B sin3x d) $A\,e^{9x} + B\,e^{-9x}$

12. Which of the following sets is countable?
a) Rational numbers b) The interval [0, 1] c) Irrational numbers d) Real numbers

13. The eigenvalues of the matrix [[3,1],[1,3]] are:
a) 2, −2 b) 6, 0 c) 4, 2 d) 3, 3

14. If A is a 3×3 matrix with det(A) = 0, then A is:
a) Singular b) Invertible c) Orthogonal d) Symmetric

15. The determinant of a triangular matrix equals:
a) Zero always b) The product of its diagonal elements c) The sum of its diagonal elements d) The square of its trace

16. The value of $\int_0^{\pi} \sin x\,dx$ is:
a) 2 b) 0 c) π d) 1

17. The Laplace transform of sinh(3t) is:
a) $s/(s^2-9)$ b) $3/(s^2+9)$ c) $s/(s^2+9)$ d) $3/(s^2-9)$

18. A continuous function on a closed and bounded interval [a, b] is always:
a) Monotonic on [a, b] b) Uniformly continuous on [a, b] c) Unbounded on [a, b] d) Differentiable on [a, b]

19. The general solution of $dy/dx = y/x$ is:
a) $y = C/x$ b) $y = Cx$ c) $y = Ce^x$ d) $y = Cx^2$

20. A monotonic decreasing bounded sequence converges to its:
a) Infimum b) Maximum c) Upper bound d) Supremum

21. The value of $\int e^x \cos x \, dx$ is:
a) $e^x \sin x + C$ b) $(e^x/2)(\sin x - \cos x) + C$ c) $e^x \cos x + C$ d) $(e^x/2)(\sin x + \cos x) + C$

22. The average value of $f(x) = x^2$ on the interval $[0, 3]$ is:
a) 1 b) 3 c) 27 d) 9

23. The sequence $b_n = \Sigma_{k=1}^{n} 1/(n+k)$ converges to:
a) It diverges b) 1 c) ln 2 d) e

24. For a subset S of real numbers bounded below, the greatest lower bound is called the:
a) Infimum b) Supremum c) Minimum d) Maximum

25. $\int_0^1 1/(1+x^2) \, dx$ equals:
a) $\pi/4$ b) 1 c) $\pi/2$ d) π

Section II: Statistics (1×25=25)

26. The standard deviation of a distribution is always:
a) Zero b) Undefined c) Non-negative d) Negative

27. In simple random sampling without replacement from a finite population, each unit has:
a) An equal probability of selection b) An unequal probability of selection c) Zero probability of selection d) A probability depending on order drawn

28. If X is a random variable with mean μ, $E(X - \mu)^2$ represents the:
a) Skewness of X b) Kurtosis of X c) Mean of X d) Variance of X

29. The best fitted trend line is the one for which the sum of squares of errors is:
a) Negative b) Maximum c) Zero d) Minimum

30. The correlation coefficient r always lies between:
a) 0 and ∞ b) 0 and 1 c) -1 and 1 d) $-\infty$ and ∞

31. Which measure of central tendency is most affected by extreme values (outliers)?
a) Mean b) Median c) Mode d) None of the above

32. In the hypergeometric distribution, the mean nK/N represents:
a) The variance b) The expected number of successes in the sample c) The mode d) The population mean

33. The median of the values 4, 8, 15, 16, 23, 42 is:
a) 16 b) 15 c) 15.5 d) 23

34. The probability of an impossible event is:
a) 0.5 b) 1 c) 0 d) Undefined

35. In usual notation, if $E(X) = 3$ and $E(X^2) = 13$, then the standard deviation of X is:
a) 13 b) 4 c) 2 d) 9

36. The expected value of a discrete uniform distribution over $\{1, 2, ..., n\}$ is:
a) $(n-1)/2$ b) $n/2$ c) $n^2/2$ d) $(n+1)/2$

37. The sum of squares of deviations is minimum when measured from the:
a) Geometric mean b) Median c) Mode d) Mean

38. The mean and variance of a Poisson distribution with parameter λ are, respectively:
a) λ and λ b) $1/\lambda$ and $1/\lambda^2$ c) λ and λ^2 d) λ^2 and λ

39. The theorem stating that the sampling distribution of the sample mean approaches normality as sample size increases is the:
a) Central Limit Theorem b) Chebyshev's Inequality c) Bayes' Theorem d) Law of Large Numbers

40. A confidence interval with a higher confidence level (e.g., 99% vs 95%), for the same sample, will be:
a) Cannot be determined b) The same width c) Narrower d) Wider

41. The mode of the data set {2, 3, 3, 4, 5, 5, 5, 6} is:
a) 3 b) 5 c) 4 d) 6

42. Fisher's ideal index number is the …… of Laspeyre's and Paasche's index numbers.
a) Arithmetic mean b) Harmonic mean c) Median d) Geometric mean

43. If a fair coin is tossed 3 times, the probability of getting exactly 2 heads is:
a) 3/8 b) 1/8 c) 1/2 d) 5/8

44. Which distribution is used for testing the equality of two population variances?
a) t-distribution b) Chi-square distribution c) Normal distribution d) F-distribution

45. Testing H_0: $\mu \leq 50$ vs H_1: $\mu > 50$ leads to:
a) One-sided upper-tailed test b) One-sided lower-tailed test c) Two-tailed test d) None of the above

46. The statistical test generally used to test association between two independent categorical variables is:
a) Z-test b) F-test c) t-test d) Chi-square test

47. The chi-square test statistic can never be:
a) Positive b) Zero c) Negative d) A decimal value

48. In a distribution, $Q_3 - Q_1 = 30$, $Q_3 + Q_1 = 90$, and the median is 42. The Bowley's coefficient of skewness is:
a) 0.1 b) 0.2 c) −0.2 d) 0.3

49. If the two observations are 15 and −15, then their harmonic mean is:
a) 0 b) ∞ (undefined) c) 15 d) −15

50. If two events A and B are independent, then $P(A \cap B)$ equals:
a) $P(A) \cdot P(B)$ b) $P(A) - P(B)$ c) $P(A) + P(B)$ d) $P(A)/P(B)$

Section III: Computer Science and Information Technology (1×25=25)

51. The phenomenon of a phosphor's glow disappearing almost immediately after excitation is called:
a) Phosphorescence b) Persistence c) Refresh rate d) Fluorescence

52. IP in the context of networking stands for:
a) Information Packet b) Interface Path c) Internet Protocol d) Internal Process

53. A deadlock in an operating system occurs when:
a) A process uses too much CPU b) Two or more processes wait indefinitely for resources held by each other c) A process completes execution d) None of the above

54. The time complexity of binary search on a sorted array of n elements is:
a) O(log n) b) O(1) c) O(n) d) O(n log n)

55. Which of the following is an example of supervised learning?
a) K-means clustering b) Association rule mining c) Principal Component Analysis d) Linear regression

56. Which SQL command removes a table completely from a database, including its structure?
a) DROP b) REMOVE c) DELETE d) TRUNCATE

57. The result of $(11010)_2 - (1011)_2$ is:
a) 01111 b) 10101 c) 11100 d) 01110

58. Which of the following statements is executed by the preprocessor?

a) void main() b) printf("Hello"); c) return 0; d) #define PI 3.14

59. Which switching technique requires a dedicated path between sender and receiver?
a) None of the above b) Packet switching c) Message switching d) Circuit switching

60. A primary key can contain:
a) Only NULL values b) NULL values c) Neither duplicate nor NULL values d) Duplicate values

61. Which of the following is not a Database Management System?
a) Oracle b) PostgreSQL c) Windows d) MySQL

62. Which protocol is used to send email?
a) FTP b) SMTP c) SNMP d) HTTP

63. In machine learning, overfitting refers to a model that:
a) Performs poorly on training data b) Performs equally well on all datasets c) Cannot be trained at all d) Performs well on training data but poorly on new/unseen data

64. Which SDLC phase focuses on gathering and documenting user requirements?
a) Requirement Analysis b) Design c) Testing d) Maintenance

65. Which of the following is a valid IPv4 address?
a) 192.168.1.1.1 b) 192.168.1.1 c) 192.168.1.256 d) 192.168.1

66. Which normal form is based on candidate keys and removes all transitive dependencies fully?
a) BCNF b) 1NF c) 2NF d) 4NF

67. What is the correct logical order of execution of clauses in an SQL SELECT query?
a) FROM, WHERE, SELECT b) FROM, SELECT, WHERE c) SELECT, FROM, WHERE d) WHERE, SELECT, FROM

68. Which of the following is an entry-controlled loop?
a) while b) Both while and do-while c) None of the above d) do-while

69. After a rollback, a transaction is in _____ state.
a) Active b) Committed c) Partially committed d) Aborted

70. Which of the following is a compiled language?
a) PHP b) JavaScript c) Python d) C

71. Which software is most commonly used for spreadsheet-based data analysis?
a) MS Paint b) SPSS c) Photoshop d) MS Excel

72. Which of the following is the most common metric for measuring algorithm efficiency?
a) Lines of code b) Programming language used c) Time complexity (Big-O) d) Memory size

73. Which layer is responsible for routing data across different networks?
a) Physical layer b) Data link layer c) Network/Internet layer d) Application layer

74. Recursion in programming is best described as:
a) A data structure b) A function that never returns c) A loop with no exit condition d) A function calling itself to solve smaller instances of a problem

75. Which of the following is used to uniquely identify a device on a network?
a) MAC address b) Domain name c) URL d) HTML tag

Section IV: Technical English (1×10=10)

76. 'Actions speak louder than words' means:
a) Actions are always loud b) Words are more powerful than actions c) Silence is golden d) What people do matters more than what they say

77. Identify the correctly punctuated sentence:

a) Although, it was raining we went for a walk. b) Although it was, raining we went for a walk. c) Although it was raining we, went for a walk. d) Although it was raining, we went for a walk.

78. Choose the correctly spelled word:

a) Recieve b) Receve c) Receiv d) Receive

79. "He is the black sheep of the family." The underlined expression has …… meaning.

a) Literal b) Poetic c) Contextual d) Figurative

80. 'By the time we arrived, the movie _____.'

a) already started b) already starts c) had already started d) has already started

81. Choose the correct comparative form: 'This problem is _____ than the previous one.'

a) more difficult b) difficultest c) most difficult d) difficult

Read the passage below and answer the questions that follow.

Urbanization has led to rapid growth of cities worldwide, bringing both opportunities and challenges. While cities offer better access to education, healthcare, and employment, they also face problems such as traffic congestion, pollution, and housing shortages. Sustainable urban planning, including efficient public transportation and green spaces, is essential to ensure that cities remain livable as populations continue to grow.

82. According to the passage, cities offer better access to:

a) Education, healthcare, and employment b) Only entertainment c) None of the above d) Agriculture

83. Which of the following is mentioned as a challenge of urbanization?

a) Excess housing b) Low population c) Abundant farmland d) Traffic congestion

84. What does the passage suggest is essential for livable cities?

a) Banning public transport b) Removing green spaces c) Sustainable urban planning d) Reducing population to zero

85. The passage is primarily about:

a) The history of cities b) Rural life c) The opportunities and challenges of urbanization d) Global warming

Section V: Logical Reasoning (1×15=15)

86. Choose the word that does NOT belong with the others:

a) Cube b) Triangle c) Square d) Circle

87. All cats are animals. No animal is a plant. Therefore:

a) No conclusion can be drawn b) All plants are animals c) Some cats are plants d) No cat is a plant

88. Pointing to a photograph, a man says, 'She is the daughter of my grandfather's only son.' If the man is not the only son, how is the woman related to the man?

a) Daughter b) Mother c) Sister d) Aunt

89. Find the missing number: 2, 5, 10, 17, 26, ___

a) 36 b) 38 c) 35 d) 37

90. Fill in the blank: MBN NBO OBP PBQ _____

a) PBR b) QBR c) QBQ d) RBQ

91. If the day before yesterday was Wednesday, what day will it be tomorrow?

a) Monday b) Sunday c) Friday d) Saturday

92. The headline "Stolen Painting Found by Tree" is ambiguous. Which rewriting says only what was most probably intended?

a) Tree Found Stolen Painting b) Painting Found Near a Tree c) Painting Found Stolen by a Tree d) Tree Stole a Painting

93. Statement: The company reported record profits this quarter despite the economic slowdown.

Conclusion I: The company is doing well.
Conclusion II: The economic slowdown affected the company.
Which one is true?
a) Neither I nor II follows b) Only conclusion II follows c) Only conclusion I follows d) Both I and II follow

94. Find the next term: 1, 4, 9, 16, 25, ___
a) 32 b) 49 c) 36 d) 30

95. Which number should replace the question mark: 7, 14, 28, 56, ?
a) 98 b) 120 c) 84 d) 112

96. Circle is to Sphere as Square is to:
a) Rectangle b) Cylinder c) Cone d) Cube

97. Fact 1: All roses are flowers. Fact 2: Some flowers are red. Fact 3: All red things fade quickly.
If the above are true, which must also be true?
I. All roses fade quickly II. Roses are flowers III. Some flowers fade quickly
a) II and III only b) I, II, and III c) II only d) None of the statements is true

98. If all Bloops are Razzies, and all Razzies are Lazzies, then:
a) No Bloops are Lazzies b) Some Lazzies are not Razzies c) All Bloops are Lazzies d) All Lazzies are Bloops

99. In a certain code, 'RIVER' is written as 'SJWFS' (each letter shifted forward by one). How is 'TABLE' written in the same code?
a) UBCMF b) TBCMF c) UBCLF d) UACMF

100. Statement: Regular exercise improves cardiovascular health and mental well-being.
Conclusion I: People who exercise regularly tend to be healthier.
Conclusion II: People should exercise every day for one hour.
Which one is true?
a) Both I and II follow b) Only conclusion I follows c) Only conclusion II follows d) Neither I nor II follows

Answer Key — Set 30

1	2	3	4	5	6	7	8	9	10
b	d	a	b	c	d	a	d	b	d
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
b	a	c	a	b	a	d	b	b	a
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
d	b	c	a	a	c	a	d	d	c
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
a	b	c	c	c	d	d	a	a	d
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
b	d	a	d	a	d	c	b	b	a
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
d	c	b	a	d	a	a	d	d	c
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
c	b	d	a	b	a	a	a	d	d
71	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**
d	c	c	d	a	d	d	d	d	c
81	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
a	a	d	c	c	a	d	c	d	b
91	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
d	b	c	c	d	d	a	c	a	b